FLIGHT

The AIRCRAFT ENGINEER & AIRSHIPS

First Aero Weekly in the World

Founder and Editor: STANLEY SPOONER

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport

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Flight

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DIARY OF FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in the following list:—

1926	
Oct. 2	**Second Yorkshire Aeroplane Club Air Pageant, Sherburn.**
Oct. 2	**28 Squadron (R.A.F.) Old Boys' Association Seventh Re-union Supper, "White Horse," Holborn, London, W.C.2.**
Oct. 7	**Col. the Master of Sempill, A.F.C. "Aero Engine Fuels of Today and Tomorrow," before R.Ae.S.**
Oct. 8	**Inst. of Aeronautical Engineers' Dinner to A. J. Cobham at Kettner's Restaurant.**
Oct.	**Schneider Cup Race at Norfolk, Virginia, U.S.A.**
Oct.	**Stefanik Prize Race at Prague.**

EDITORIAL COMMENT.

A CROWD variously estimated at from 15,000 to 30,000 people visited the Air Pageant and Air Race Meeting organised under the competition rules of the Royal Aero Club of Great Britain by the Lancashire Aero Club on Sunday last, September 26. When it is remembered that the Club's aerodrome at Woodford (actually *just* in Cheshire) is something like 16 miles out of Manchester, is very inaccessibly located, and that the weather was extremely threatening, with heavy rain in the morning, it will be realised what enthusiasm, what dogged determination to see flying at any sacrifice, the presence of such a crowd represents. The fact that the Pageant was held on a Sunday doubtless contributed not inconsiderably to this phenomenal attendance, but even making every allowance for this fact, the keenness of the good Lancastrians is something to be marvelled at—and, incidentally, to be very grateful for. We could wish that a similar spirit were a little more in evidence slightly closer to the banks of the Thames. The fact that a very good programme had been arranged, that the organisation was good, and that the weather kept fine could not have been foretold, and thus could not have contributed to the attendance even if all these things did materially assist in making the meeting a success once the multitudes reached Woodford. The obvious inference, therefore, is that flying appeals very strongly to our friends in the north, and whatever hardships many of the visitors had—must have had—to endure on Sunday last in the form of long tramps on foot, cramped journeys in 'buses, or tiresome rides on "push-bikes," not one word of complaint was heard from anybody, and the crowd was one of the most genuinely interested and best behaved it has ever been our good fortune to encounter. This in spite of the fact that the ground was sodden from the heavy rains and all the visitors (a large proportion of whom were of the "gentler" sex) had to stand with cold wet feet

An Amazing Anniversary

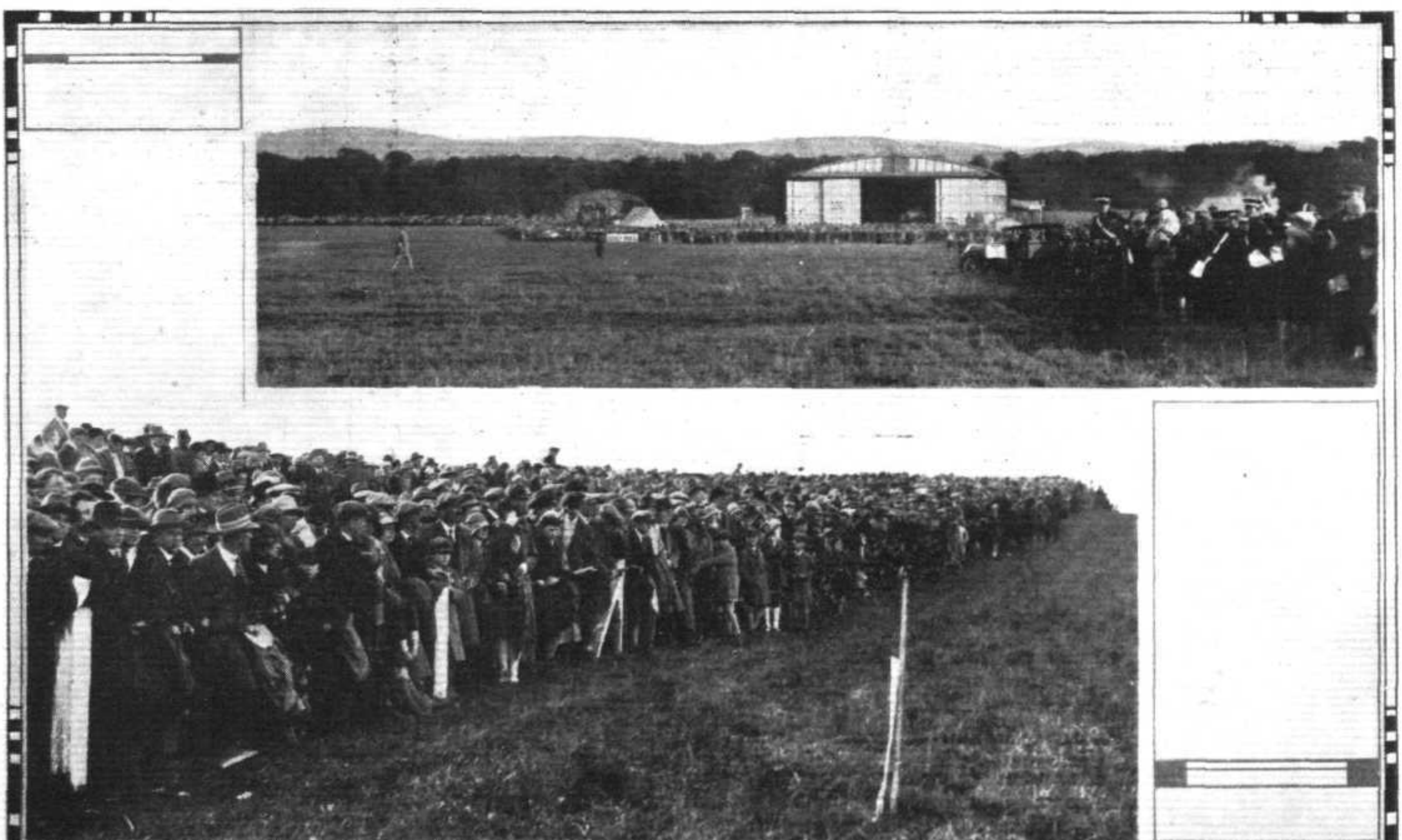
for something like seven hours. It would be difficult indeed to find a better proof of the intense interest which the Manchester district takes in aviation, and when the Air Ministry is looking around for ways and means of developing the " air sense " we suggest that here is fertile ground only awaiting cultivation.

Already the Lancashire Aero Club has done some extremely good work, as will be realised when we point out that during the one year in which the Club has been actively engaged in flying (work was commenced on September 29, 1925) its machines have flown 785 hours, which represents approximately 51,000 miles, or about 4,000 separate flights. During that period seventeen members have been trained up to the point of taking their pilot's certificate, and no serious accident or injury to any member has been caused. Three mishaps have occurred in which machines were damaged, but in no case was the pilot even scratched. This is a record of which Mr. John Leeming, the Club's chairman, and those associated with him may well be proud, and Sunday's success was well earned and will, it is hoped, have enriched the exchequer by a substantial amount.

Concerning the Lancashire Air Pageant itself a fully illustrated report is given elsewhere in this issue, and there is little need to refer here to more than one or two phases which appear to us to merit special mention. One was the arrival, through some of the worst weather of the season, of the various competing machines. A large number of these, in fact the majority, were of the low-power type, with engines which in most instances did not exceed 75 h.p., and in many cases were of lower power than that. Yet in spite of the very adverse weather conditions—wind, rain and thunderstorms, all these little machines without exception arrived at Woodford during the day preceding the meeting. This fact demonstrates to the full, if such proof were needed, the great advance that has been made of recent years in the airworthiness of aeroplanes of relatively low power.

Another excellent feature of the Woodford meeting was the participation by service pilots on R.A.F. aeroplanes in the demonstration flights. This provided a proof of the really serious way in which the authorities regard the light 'plane movement, and we hope that, now that the " propriety " of such participation has been officially accepted, at any rate " in principle," the R.A.F. will be allowed to take an increasing part—in a dignified and proper service manner, of course—in similar aviation events. The presence of Squadron-Leader Longton and Flying-Officer Waghorn, merely as individuals on civilian machines, represented a principle which has long been recognised, but was none the less welcomed for that.

One little item from the Lancashire meeting—not in itself a very conspicuous one, but one which may in time become of great importance—was the offer by A. V. Roe & Co., of free landing and housing facilities from Saturday till Monday for all machines visiting the aerodrome. This " sporting gesture " was one which the Air Ministry might well copy. At the moment we have not very many privately-owned machines (and among privately-owned we include the light 'plane clubs' machines), but as time goes on the number will grow. It would, we think, be very good policy on the part of the Air Ministry to offer free landing and housing facilities (the latter for a reasonable period, of course) to such machines at those service aerodromes on which civilian aircraft are permitted to land.



[" FLIGHT " *Photographs*

" WHAT LANCASHIRE THINKS TO-DAY " : Two views showing the crowds which assembled to see the Lancashire Air Pageant at Woodford Aerodrome on Sunday last. These two views were taken from the same view-point, one looking down the hill towards the hangars, and the other up the hill towards the aerodrome boundary. It is estimated that some 20,000 people visited the Pageant.

THE LANCASHIRE AIR PAGEANT

Meeting at Woodford an Unqualified Success

THE Lancashire Aero Club celebrated its first anniversary (the Club having commenced active flying on September 29, 1925) by holding at the Woodford Aerodrome, outside Manchester, on Sunday last, September 26, an air pageant and air race meeting under the competition rules of the Royal Aero Club of Great Britain. From every point of view the meeting was a success. It is estimated that something like 20,000 people visited the aerodrome for the meeting, and, although it is to be feared, from the point of view of the coffers of the club, that not all of these paid their entrance fee, the club has undoubtedly gained a very substantial addition to its funds. And richly it deserved it. Not only was the meeting well planned and well organised, but purely as one of the light 'plane clubs the Lancashire Aero Club has, in its one year of existence, done some extremely valuable work for the cause of aviation. Sunday's meeting was one of which any club might have been justly proud, and upon the success of which the Club's energetic and popular chairman, Mr. John Leeming, and his fellow-workers are to be heartily congratulated.

["FLIGHT" *Photographs*

THE LANCASHIRE AIR PAGEANT: Above the machines parked close to the enclosures, and below, the parade past the spectators.

"On to Manchester"

Not the least gratifying side of the meeting was the manner in which aeroplanes of all sorts, but mostly of low power, arrived from all over England on the day before the meeting. Saturday, it may be remembered, was one of the worst days we have had for a long time. In spite of strong winds, rain, poor visibility, thunderstorms and the like, these little aeroplanes fought their way from Newcastle, Leeds, Stag Lane, Croydon, and Hamble to the Woodford Aerodrome, in Cheshire, in order to take part in the meeting. It would be difficult to find a better illustration of the progress which has been made in low-power flying of recent years than this converging of light 'planes upon Manchester, not with fabulous prizes as the potential reward, but purely in order to take part in a meeting which had been scheduled, and which nobody wished to miss if it could possibly be avoided. Naturally enough, the de Havilland "Moths," the standard type of the light 'plane clubs, were in the majority, but a number of other machines also attended, such as the Blackburn "Bluebird" with Armstrong-Siddeley "Genet" engine, the Avro "Avian" with the same type of engine, the De Havilland "Genet-Moth," the Nimbus-Martinsyde, the S.E.5, and the Avro "Gosport" fitted with the new 100 h.p. Avro "Alpha" engine. In this connection it is, we think, worth placing on record the fact that Mr. Bert Hinkler, accompanied by Mr. R. J. Parrott, made the flight from Hamble to Woodford aerodrome in 2¼ hours in the Avro "Avian." This machine, by the way, has had its wing span reduced since the Lympne competition, the span now being 26 ft. as against the 32 ft. of the Lympne wings. The machine is, of course, considerably faster with the smaller wings, and the rough estimate which we made in FLIGHT last week of 105 m.p.h. appears to have been exceeded. Mr. Parrott informed us that most of the way up from Hamble the "Avian" was cruising at, roughly, 90 m.p.h. on half-throttle.

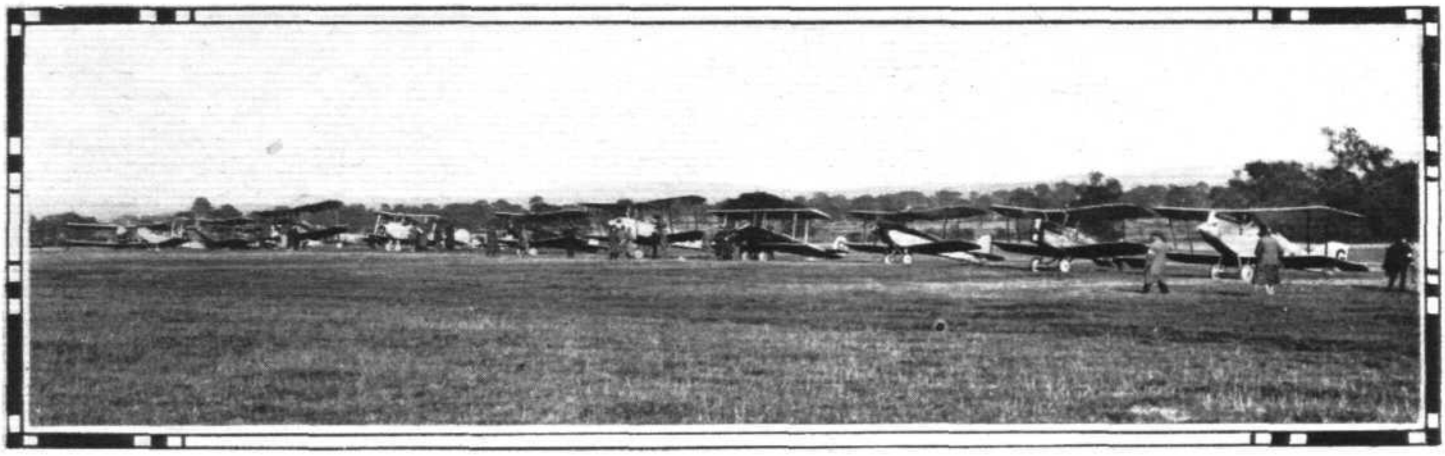
A very welcome newcomer at Woodford was the Avro "Gosport" with the new Avro "Alpha" engine. This engine, a five-cylinder radial air-cooled, has been developed at the Manchester works of A. V. Roe and Co. during the last year or so, and, although at the moment it has not yet passed its Air Ministry type tests, there is no reason whatever to doubt that it will soon do so. The history of the engine is interesting, but only a very brief reference to it can be made here. Wishing to have available for use in the new Avro "Gosport" an engine of about 100 h.p., simple and cheap to build and to maintain, work was commenced on a five-cylinder radial. But a single engine was constructed for a start, and this was naturally run a good deal, both on the test bench and in Avro aeroplanes. One does not possess actual figures relating to the number of hours so run, but they were considerable. When the engine showed promise of good reliable running, it was decided that one very good way of finding out any "weak spots" that might exist would be to submit it to the Air Ministry type tests, not with any idea of attempting to pass the tests, but purely "to see what would happen." The "Alpha," as the new Avro engine is to be named, continued to run, and it was not until it was on its eighty-third hour's running that anything went wrong. Then a split-pin sheared and a nut came adrift—truly not a serious breakdown as far as the engine itself goes—and further running had to be deferred. When it is recalled that but a single engine was built, was experimented with on the test bench and in the air, and then ran for 83 hours under type-test

[" FLIGHT " *Photograph*

THE LANCASHIRE AIR PAGEANT : Not a " wheelbarrow race," but an incident in the inter-club relay race.

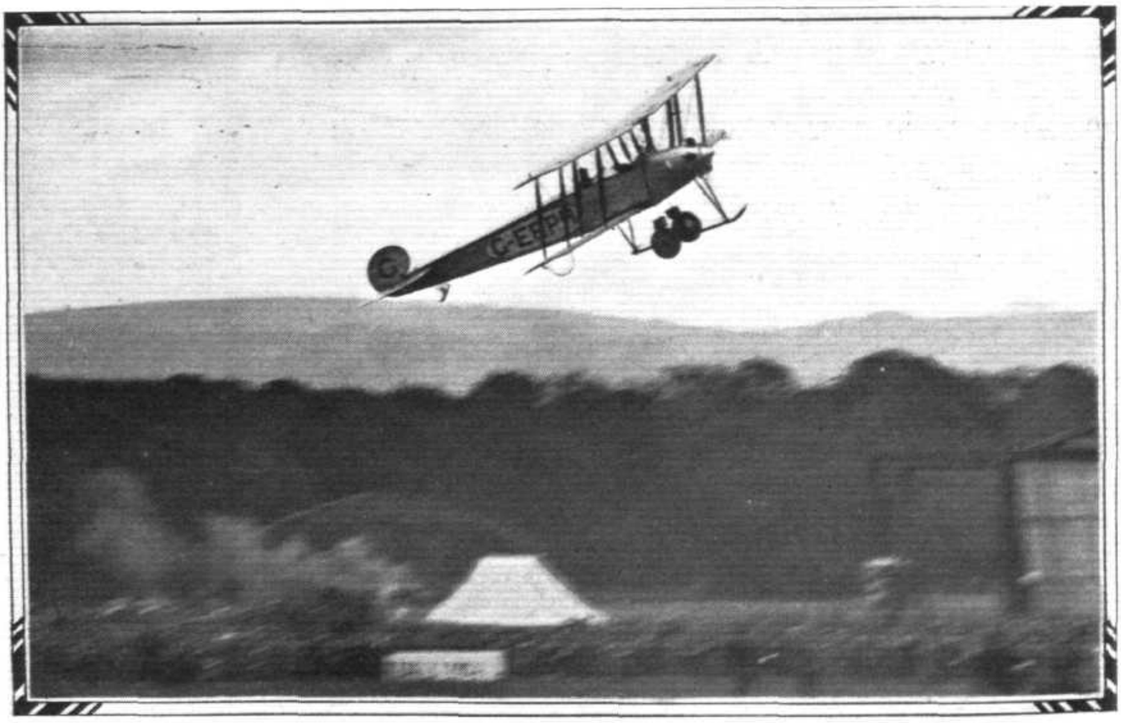
conditions before anything went wrong, we think it can be claimed as something of an achievement, the more so as Avros are not an engine firm, or at least *were* not until the production of the " Alpha." Fitted into the nose of the Avro " Gosport," the " Alpha " looks extremely neat, the simplicity of the overhead-valve arrangement, etc., resulting in very neat cylinder-heads. It is regretted that at the moment a detailed description cannot be given.

To return to the Lancashire pageant, a very welcome feature of this was the presence and participation of Royal Air Force machines—Bristol Fighters and Sopwith Snipe—which seemed to indicate that the Air Ministry and the R.A.F. are taking a real interest in the work of the light 'plane clubs, and there can be no doubt that the aerial combat between a Bristol Fighter and a Snipe, as well as the demonstration of formation flying by three Bristol Fighters of No. 5 F.T.S., Sealand, were greatly appreciated by the large crowds assembled at Woodford.



[" FLIGHT " *Photograph*

THE LANCASHIRE AIR PAGEANT : Line-up of 10 machines for the Open Handicap Race.



[" FLIGHT " *Photograph*

At the Lancashire Air Pageant : Flying Officer Waghorn winning the Open Handicap on the Avro " Alpha-Gosport."

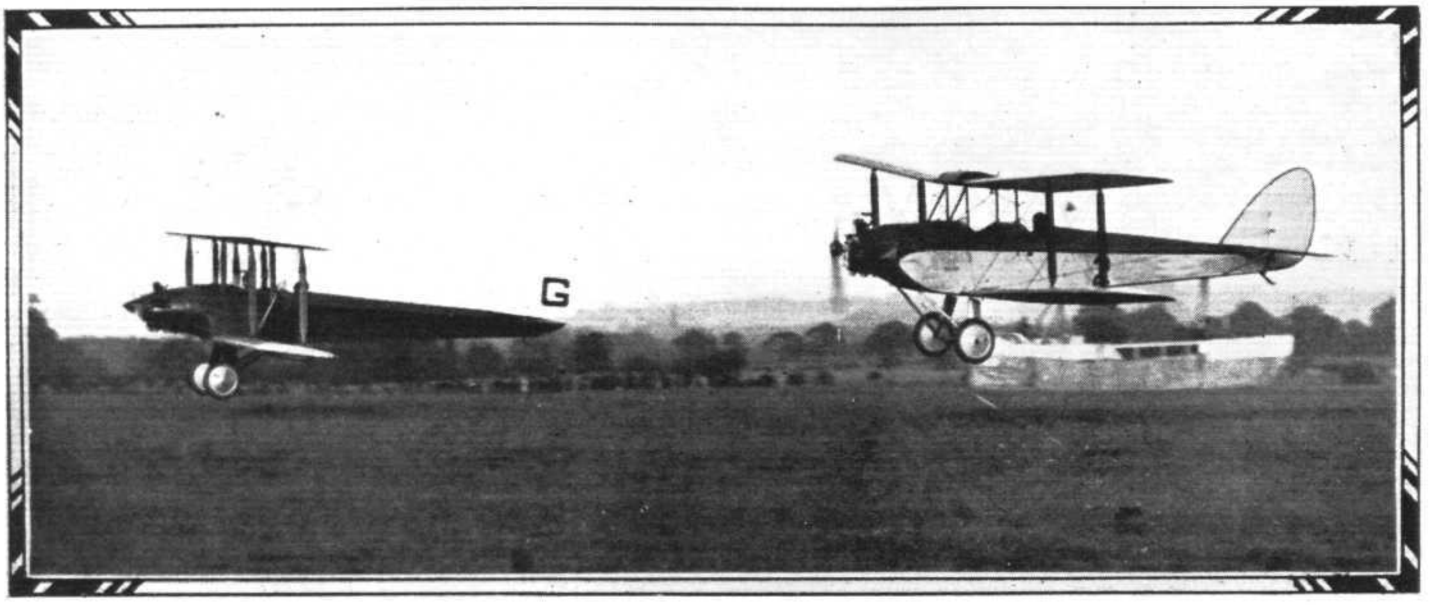
An Excellent Programme

In spite of the fact that Woodford aerodrome is very inaccessibly situated, crowds of visitors streamed towards the aerodrome during the morning and early afternoon. The weather was far from promising and, in fact, during the early morning, the rain poured down on Manchester so that one began to despair. A telephone call to Mr. John Lord, of Avros, however, resulted in an immediate promise of a conveyance, and in a few minutes Mr. A. P. Wood, of dynamo fame, very sportingly called at the hotel with his car, and with Mr. Wood, junior, as "pilot," the trek to Woodford commenced. By this time the rain had left off, although the clouds still hung very low, and as mile after mile was left behind and Woodford approached, diminutive spots of blue sky began to appear. From all directions people converged upon the aerodrome, by car, motor cycle, "push-bike," and on foot, and the narrow lane leading from the main road down to the 'drome was closely packed, the stream advancing at the rate of about 2 m.p.h.

Upon reaching the aerodrome some 30 machines of various types, but with "Moths" naturally predominating, were seen round about the hangar. The public enclosures paralleled the road for a distance of close on a mile, and were packed with spectators arranged in two tiers, that nearest the road being raised some little distance. In this respect Woodford provides a sort of natural grand stand, quite a good view of the aerodrome being obtained even from the far end, owing to the slope of the ground.

The first event—a parade and fly-past of all the machines, was scheduled for 2.30 p.m., and with some minutes to spare it became possible to examine the official programme. This was found to be a model of what a programme of this nature should be. Not only were the registration numbers of the various machines, the names of their pilots, and the club, firm, or individual to whom they belonged stated, but a paragraph explained, briefly but clearly, the system of marking civilian aircraft. Scattered throughout the programme were explanatory notices concerning machines, the aims and objects of the Lancashire Aero Club, the system of training in force, etc., and one paragraph called attention—with pardonable pride, to A. V. Roe's first flight on June 8, 1908. All of this, of course, in addition to the fullest particulars relating to the various events of the afternoon. We do not know who edited the official programme, but it was certainly a creditable effort.

The parade and fly-past were so arranged that the machines left the park in front of the hangars, taxied up the hill *close to the enclosures* where everyone could see them, turned around down-hill and then took off into the wind. The scheme was admirably conceived, and the fact that Courtney could not get his "Nimbus" to start until after considerable

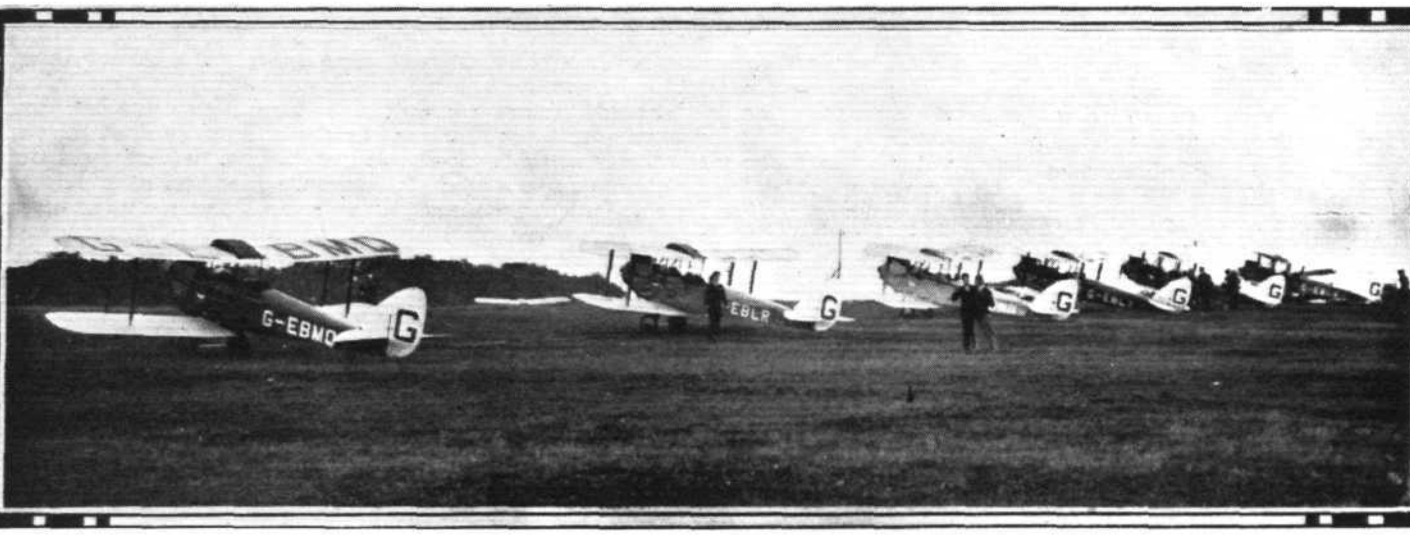


["FLIGHT" *Photograph*

THE LANCASHIRE AIR PAGEANT: The Avro "Avian" and the de Havilland "Moth," both with "Genet" engines, starting neck-and-neck in the Open Handicap.

["FLIGHT" *Photograph*

THE LANCASHIRE AIR PAGEANT: Captain Courtney on the A.D.C. Nimbus-Martinsyde starts scratch in the Open Handicap.



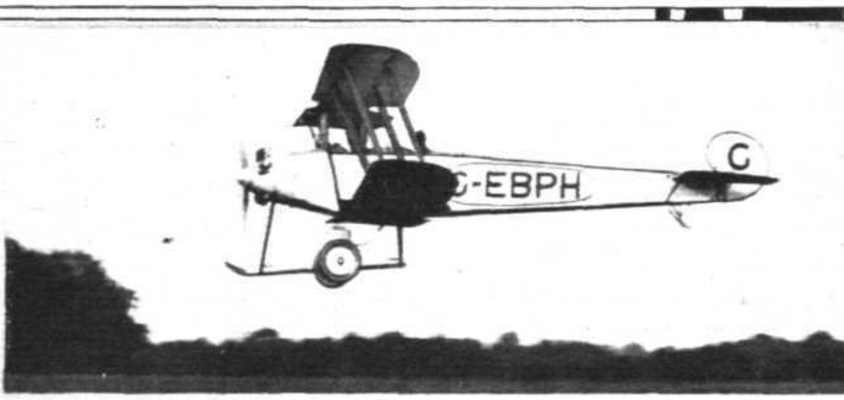
["FLIGHT" Photograph

THE LANCASHIRE AIR PAGEANT: Line-up of six "Moths" for the start of the Inter-Club Members' Race. This was won by Mr. Lacayo, on the Lancashire Aero Club's G-EBLV.

delay was, of course, in no way to be blamed upon the organisers. Longton also had trouble with the "Genet" of his Blackburn "Bluebird," but when he ultimately did get going—last of all—he made up for the delay by giving a demonstration of crazy flying just in front of the enclosures and about 6 ft. off the ground. It is to be hoped that nobody in the crowd was induced to think that this is the normal mode of progression of the "Bluebird."

The second event on the programme was an aerial combat between a Bristol Fighter and a Sopwith "Snipe," both machines belonging to the R.A.F. and being manned by Service pilots. In addition to the demonstration of air fighting, these two machines also gave exhibitions of stunt flying, the upside down flying of the "Snipe" being particularly good. A slight gap between this event and the following one, an inter-club team race, was filled in by Hinkler on the Avro "Avian" with Armstrong Siddeley "Genet" engine. The "Avian" gave an impression of being extremely manœuvrable and Hinkler, among other demonstrations, made a series of approximately twelve loops right across the aerodrome, each loop being of very small diameter and the machine losing no height whatever. It was very noticeable that Hinkler appeared to be flying on half throttle throughout, never troubling to open out the throttle for climbing nor to close it upon reaching the top of the loops, so that the machine seems capable of looping and other evolutions with the engine running at very much less than full power.

In many ways the most amusing event of the day was No. 3, an Inter-Club Team Race for De Havilland "Moths." This event was open to one team of four pilot members of



["FLIGHT" Photographs

"VENI, VIDI, VICI": On its first appearance in public the new Avro "Alpha" engine in the Avro "Gosport" won the Open Handicap, piloted by Flying Officer Waghorn. The lower photograph gives a good idea of the clean lines of the nose with this engine, while the inset shows the machine in flight.

each club, and was arranged in the following manner. Two machines took part in each heat, being placed on a line marked out on the aerodrome. The two pilots started from another line 50 yards behind the first one, and each pilot had to run this distance to his machine, fly a given circuit and land on the original starting line, running from there back to the other line, where the second pilot was waiting to take over the message. The second pilot then had to run to the machine, take off and make his circuit, and the previous proceedings were then repeated. If a pilot overshot the mark, he and his partner had to wheel the machine back to the original starting line, taxying on the ground not being permitted.

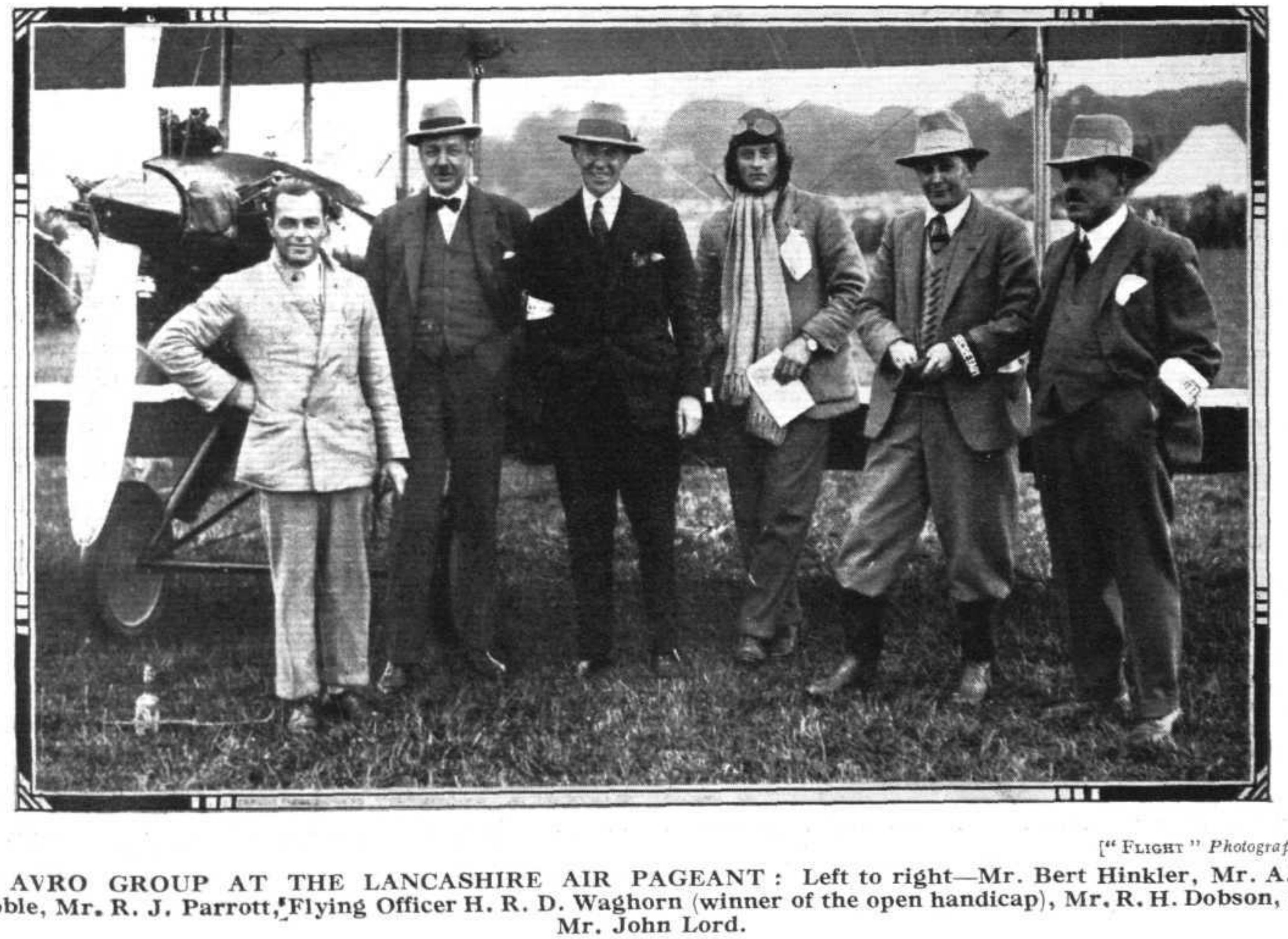
The four clubs and their teams taking part in this race were as follows :—The Yorkshire Aero Club: R. W. Kenworthy, H. S. Carter, E. B. Fielden and H. S. Norway. The Lancashire Aero Club: J. J. Scholes, T. N. Stack, A. Goodfellow and B. Leete. The Newcastle Aero Club: P. F. Heppell, F. H. Phillips, E. B. Ellis and H. L. B. Dixon. The London Aero Club: Major K. M. Beaumont, D.S.O., W. Hay, C. H. Craig and F. G. M. Sparks.

This event was watched with great amusement, and quite early in the proceedings the Newcastle Club became favourites by the keenness with which they tackled the job, two of their pilots doing their sprinting and flying their circuits in shirt-sleeves. In coming in to land, too, the Newcastle Club appeared to score, in that several of the Newcastle pilots on G-EBLX made quite amazing side-slip landings. Incidentally, this event gave a very good demonstration of the sturdy construction of the De H. "Moth," the machines being landed time after time on the right-wing tip, which frequently could be seen to bend slightly upon touching the grass, but apparently without any ill-effects whatever. In the final the Newcastle Club scored an easy and certainly well-deserved victory, thus winning the first prize of four engraved silver tankards presented by Mr. Sawley Brown.

Before the start of Event No. 4, the Avro "Avian" was very thoroughly filmed, Hinkler piloting the "Avian," and Flying Officer Waghorn the Avro "Gosport."

The big event of the meeting was No. 4, an Open Handicap Race for which no less than 18 machines had been entered. Unfortunately, some of the entries were prevented from taking part in the race, but 10 machines toed the line and got away in the following order :—Two De H. "Moths," G-EBLS piloted by R. W. Kenworthy, of the Yorkshire Aero Club, and G-EBLR piloted by M. Lacayo of the Lancashire Aero Club, started as limit men, followed by T. N. Stack, on

The new Avro "Alpha" engine.



["Flight" *Photographs.*

AN AVRO GROUP AT THE LANCASHIRE AIR PAGEANT : Left to right—Mr. Bert Hinkler, Mr. A. W. Hubble, Mr. R. J. Parrott, Flying Officer H. R. D. Waghorn (winner of the open handicap), Mr. R. H. Dobson, and Mr. John Lord.

Renault-Avro G-EBOK of the Lancashire Aero Club. Next was N. Woodhead, on the Blackburn "Bluebird," which was followed by G-EBMF, of the London Aero Club. Next came the Avro "Alpha-Gosport" E-EBPH, piloted by Flying Officer Waghorn. Hinkler, on the Avro "Avian," and Broad on the de H. "Moth," both with Armstrong-Siddeley "Genet" engines, were given the same time allowance and were followed by Mrs. Eliott-Lynn on her S.E.5, G-EBPA. Scratch man was Capt. Courtney on the A.D.C. "Nimbus-Martinsyde."

The following prizes were offered for this event :—1st Prize, a Cup valued £40, presented by Mr. S. E. Rodman, the winner to hold the cup for twelve months, and to receive a replica and £20 in cash. 2nd Prize, £10 cash, presented by the De Havilland Aircraft Co., and 3rd Prize, value £10, presented by the British Aviation Insurance Group.

This race was held over a triangular course of 28 miles, the turning points being Goyt Mill, Marple, and the Water Tower, Knutsford. The machines were in sight almost throughout, although on the homeward leg from Knutsford they flew very low and occasionally disappeared behind the trees in the valley. The first five machines crossed the finishing line fairly close together, with Waghorn on the Avro "Alpha-Gosport" in the lead, closely followed by Woodhead on the Blackburn "Bluebird," and Hinkler on the Avro "Avian," third. Thus, the new Avro "Alpha" engine won its first victory on the occasion of its first appearance, which must be very gratifying to the Avro Company. Hinkler and Broad had started together on the "Avian" and on the "Genet-Moth," but Broad was left behind owing, it is believed, to the fact that with the present cowling of the "Genet" in the "Moth," the engine was running rather too cold, and started missing, although it picked up again almost immediately. We believe that at Lympne, Hinkler had a somewhat similar experience on account of the air intakes sucking in cold air instead of hot. Even apart from this, however, it seems doubtful whether at the moment the "Moth" is quite as fast as the "Avian." Mrs. Eliott-Lynn was 4th, on her S.E.5, by no means a bad performance, as she has had very little experience of air racing, and even less of handling the S.E.5.

Event No. 5, an Inter-Club Members' Race open to standard "Moths" only, was a scratch race, but in order to avoid any chance of accident the machines were started at 30 seconds intervals. Although this was doubtless a very wise precaution it rather reduced the interest of the visitors, owing to the impossibility of following straightaway the relative position of the various competitors. This race was over a triangular course of 14 miles, the turning points being Coyt Mill, Marple and Bleach Works, Handforth. For this event Mrs. John F. Leeming had presented a challenge cup, value £40, the winner to hold the cup for 12 months and to receive a replica. The second and third prizes were of £5 each. This race was won by Mr. M. Lacayo of the Lancashire Aero Club, Mr. C. N. Parker, of the same club, being second, with Mr. M. B. Lax, of the Yorkshire Aero Club, third.

At the end of this race some extraordinarily fine flying exhibitions were given. Longton again brought out the Blackburn "Bluebird" and gave an exhibition of crazy flying, which was one of the most amazing performances one has ever seen, and certainly this machine seems to be very manœuvrable, while the manner in which it hangs in the air at apparently scarcely any forward speed at all is quite astonishing. Some perfectly flat turns at low altitude were most impressive. Capt. Broad then took out the De Havilland "Genet-Moth" and gave some extremely fine demonstrations of stunt flying, his large diameter loops, which finished only some 100 ft. above the ground, being very impressive indeed.

["FLIGHT" *Photograph*

"BLACKBIRDERS" AT THE LANCASHIRE AIR PAGEANT : Mr. B. Flinton, Squadron-Leader Longton, D.F.C., A.F.C., Mr. A. C. Thornton, designer, under Major Bumpus, of the Blackburn "Bluebird," and Mr. Norman Blackburn.

In the meantime Capt. Courtney had obtained permission to try the Avro "Avian," and as he had never been in the machine before it was naturally expected that he would just take the machine up to test the controls and then perhaps indulge in some rather mild stunting. To the amazement of everyone, however, after making one circuit of the aerodrome to get accustomed to the controls, Courtney proceeded to stunt the "Avian" in the most approved style, one of the most remarkable shows being flights right across the aerodrome at low altitude with the machine banked over to an angle of at least 45° and seemingly "skating" on the side of its fuselage, without losing any appreciable height. Some very steep side slips to within a few feet of the ground were also greatly appreciated. Upon landing Capt. Courtney expressed himself delighted with the "Avian," which he rather wittily called the "Avro 'ave-one" with "Gin-and-it" engine.

The next item on the programme was to have been a display by Bristol Fighters of picking up messages, but owing to the fact that previous events had taken rather longer than expected, this had to be cancelled, its place being taken by Event No. 7, a landing competition for Club "Moths" only, in which Club members (excluding pilot instructors), were required to land over a line, points being awarded equally for style of landing and distance from line upon coming to rest.

(*Concluded on p.* 642.)

The AIRCRAFT ENGINEER

FLIGHT ENGINEERING SECTION

Edited by C. M. POULSEN

September 30, 1926

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OUR CONTRIBUTORS

Mr. J. D. North, who has been a regular contributor to THE AIRCRAFT ENGINEER since its second number, is an "Absentee" (but not without leave) this month, having informed the Editor that he proposed to take a holiday and consequently being unable to send in his usual contribution. Much as we know our readers will miss his customary article, we feel sure they will join us in expressing the hope that Mr. North will derive every possible benefit from his rest, and that he will return to harness with renewed zest and with, if possible, an increased "Performance."

Dr. Leslie Aitchison was the absentee last month, but in the present issue he returns with a further article on Duralumin. Among the subjects dealt with by our foremost authority on Duralumin are those of "grain" and of "discontinuities." Concerning the former, Dr. Aitchison points out that Duralumin differs from steel in that it can be extruded. The grain produced by extrusion is not quite as fine and elongated as that produced by forging. As regards the difference in properties between specimens tested across the grain and parallel with the grain, the author points out that this difference depends largely upon the amount of working, the worst case being the intermediate condition between slight forging and heavy working, for which, in large forgings, he suggests taking a figure for uniform strength throughout the forging of about 22 tons per sq. in.

On the subject of "discontinuities" Dr. Aitchison makes some interesting observations, and he definitely denies that the phenomenon which used to be popularly known as "laminations" is due to blow-holes, using instead the expression "discontinuities," and pointing out that these are the product of the arrangement of the macro-crystals of the metal in the cast state. Discontinuities only become evident when the material is fractured in bending, in other words, their appearance is connected with severe cold distortion. The discontinuities do not spread when exposed to normal stresses.

Mr. W. S. Hollyhock who is, we understand, employed by A. V. Roe & Co., contributes an article on "Lug Design," which should be of assistance in the drawing office in reducing the amount of work involved in obtaining the proportions of any lug of normal design.

DURALUMIN.

By LESLIE AITCHISON, D.Met., B.Sc., F.I.C., M.I.A.E.

(*Continued from p.* 67.)

All users of forgings and drop forgings regard as an ideal a part which, when treated and machined, shall be uniform in mechanical properties throughout. One of the difficulties of securing complete uniformity of properties in a large forging has been indicated in connection with the very powerful influence exercised by the mass upon the rate of cooling, and consequently upon the degree of hardening of Duralumin parts. There is another factor that necessarily enters very considerably into the question of uniformity of mechanical properties, and this one operates upon both small and large forgings. The factor in question is that of "grain." The effect of this property is, of course, operative in respect of all metals, and Duralumin forgings are not at all exceptional in being subject to its influence.

Perhaps it is not very necessary at this date to enlarge upon the nature of grain, beyond saying that the grain in Duralumin is produced just as that in steel by the elongation of the macro-crystals of the cast metal in a direction parallel to the principal elongation of the part during rolling, forging and drop forging. It is obvious that the degree to which the grain is developed in a metal is a function of the extent to which the material has been worked in any one direction, and it is also very evident that if a large and a small ingot are worked down to the same size of bar, the fibres composing the grain are likely to be longer and finer in the bar produced from the large ingot than in that produced from the small ingot. In general it may be taken as pretty certain that the production of a fine elongated grain is to be preferred over that of a coarser and shorter grain.

Duralumin, of course, differs from steel in one important respect, namely, that it can be extruded. Naturally, the extrusion process produces results that are somewhat analogous to those produced by rolling or forging. In an extruded bar a definite grain is developed, but in general the grain has not been drawn out quite to the same extent in an extruded bar as it would be in a forged bar of the same size produced from an ingot of the same cross-section as that employed for extrusion. A given percentage of reduction of cross sectional area produced by forging has a more pronounced effect upon the grain than the same degree of reduction brought about by extrusion.

In steel it is customary to assume that the influence of the grain upon the mechanical properties is confined to the toughness and the ductility. In general, this assumption has

been pretty well borne out in practice, though of course, a certain number of exceptions occur which indicate that sometimes the maximum stress is also slightly affected by the grain. In Duralumin the ductility and the toughness are lower in a specimen tested in tension when the stress is applied in a direction at right angles to the governing direction of the grain than it is in a corresponding specimen tested so that the stress applied is parallel to the grain. As with steel, the degree of difference in properties in the two directions is not absolutely constant and depends, amongst other things, upon the amount by which the metal has been reduced in forging. The light alloys, in addition to showing the effect of a cross grain in their ductility and toughness, also show the influence of grain in their tensile properties. The extent to which the grain affects these properties is very particularly influenced by the amount of mechanical work that has been done upon the metal. In a specimen that has only been lightly worked the difference in the results obtained from longitudinal and transverse test specimens is not very great. When more work has been done the disparity in properties in the two directions increases. If much further work is done the disparity both in strength and in ductility begins to lessen, and in fact, finally disappears in moderately rolled metal. Obviously it is somewhat difficult, therefore, to estimate exactly what will be the difference in properties between longitudinal and transverse specimens, without complete information as to the size of both the original casting and the finished parts, as well as of the conditions under which they have been produced. The safest thing to do appears to be to consider the worst case, namely, the intermediate condition between slight forging and heavy working. A general survey of a considerable quantity of tests indicates that the difference in tensile strength between representative specimens, longitudinal and transverse, will be of the order of 3 to 4 tons per square inch. This means that a tensile specimen *cut longitudinally from a fully heat treated* and aged forging would have a maximum stress of 25 tons, whereas a transverse test piece cut correspondingly would have a maximum stress of only about 21·5 to 22 tons per square inch. This represents the greatest extent of the disparity in properties in the two directions.

These variations in the strength and ductility of a forging should, of course, be taken into account by the designer. Probably it is only in large forgings that any serious notice need be taken of the mechanical effects of the grain, and it seems reasonable to assume that the effect can be taken into full account by assuming a uniform strength of about 22 tons per sq. in. throughout the forging, except where the influence of mass is exceedingly prominent.

As has been stated above, the difference in strength of Duralumin in the two directions parallel and perpendicular to the grain becomes quite negligible in rolled metal. In such material there is no need at all to make an allowance for any difference in properties parallel to, and at right angles to, the grain. This applies to the ductility as well as to the strength properties of the metal.

This seems to be a convenient stage at which to make some reference to a property of Duralumin which is frequently misunderstood in its scope and effects. It is frequently stated that Duralumin suffers from "laminations," and very frequently these "laminations" are popularly ascribed to the effects of blow-holes. The most usual way of demonstrating the existence of these alleged defects is to fracture a specimen of the metal by bending. Applied to thick material this form of fracture sometimes reveals smooth facets lying amongst the torn and distorted ends of the fibre which constitute the great majority of the fracture. These smooth facets have, in the past, been referred to as laminations. This is clearly a misnomer, and it is usual to recognise this fact now by referring to the facets as "discontinuities."

It can be taken as axiomatic that these discontinuities are a regular feature of wrought light alloys, and that they have their origin in certain phenomena that are inseparably connected with the behaviour of these materials during casting. They are not blow-holes, neither are they the offspring of blow-holes. On the other hand, they are not localities marked by non-metallic inclusions, neither are they places from which non-metallic inclusions have been removed during the process of fracture. Undoubtedly these discontinuities, which are invariably found in some measure in wrought light alloys, are the product of the arrangement of the macro-crystals of the metal in the cast state. These arrangements, of course, can be controlled to a certain extent by the foundryman, and it is possible by inferior skill in this operation to produce such an arrangement of the crystals as leads to the presence of discontinuities of an unusual size, or to the occurrence of an unusually large proportion of them in the metal. What appears, however, to be entirely certain is that up to the present no method of casting has been developed which results in Duralumin or the other wrought light alloys being entirely free from these discontinuities.

It is a very striking thing that the discontinuities only become evident when the material is fractured in bending—that is, in such a way that the maximum opportunity is provided for the separation of contiguous crystal faces. In other words, the display of the smooth facets is a function inseparably connected with severe cold distortion. If a sample of metal, containing discontinuities to a normal extent, is sectioned and examined microscopically, no evidence whatever can be found of those places which, when the metal is fractured, give rise to the facets termed discontinuities. This, of course, is entirely in harmony with what has been said respecting their method of origin, and with the fact that the discontinuities are not associated with blow-holes or non-metallic inclusions. Evidently then the discontinuity which shows itself after fracture is not an internal lesion in the material existing apart from the fracture, any more than the boundary line between two crystals of ferrite in mild steel is an internal defect. (The evidence appears to tend in the direction of showing that there is a good deal of similarity between the two examples mentioned.) A further point of interest in this connection is that it is only possible, in the ordinary way, to detect discontinuities when the material is in a comparatively thick condition. It is, of course, in this condition in which the material can most readily be fractured by tearing, but apart from this fact there is ample evidence that the discontinuities do disappear from observation when Duralumin is rolled down to sheets of ordinary thickness. This could not happen if the discontinuities were serious internal lesions. It is quite certain that such defects, if they existed, would not weld up again during cold working, and the fact that they cannot be distinguished in severely worked material seems to point again to the fact that discontinuities are merely the attributes of specific arrangement of crystalline material, and that they are not internal defects.

Another feature of great importance is the mode of distribution of the discontinuities: When these phenomena were first commented upon and were miscalled laminations it was frequently imagined that they ran for considerable distances through the metal. In other words, it was thought that if two fractures taken near together from a piece of metal, each showed a "lamination," there was evidence of the same "lamination" in each fracture, and that the "lamination," therefore, extended for a considerable distance through the material. This idea has definitely been disproved, and it is quite certain that individual discontinuities are quite small affairs. Their distribution is akin to that of an attenuated shoal of small flat fish, which is quite different from that of a squashed whale. In Chestertonian phrase the conspicuous feature of the distribution of discontinuities is its discontinuity.

In view of the above explanation of the nature of these characteristic formations in Duralumin it becomes possible to assess with some reasonable prospect of success the influence of the discontinuities upon the mechanical properties of the material. It is obvious from the outset that since discontinuities which are revealed on fracture are not pre-existent internal cracks, they cannot be regarded as potential sources of weakness in material that is exposed to normal stresses. In other words, they are not portions of the material at which there will be local concentrations of stress, neither are they localities infested with sharp corners,

which when stressed will develop into destructive cracks. This means that Duralumin that is normally stressed will not fail in consequence of the enlargement of the discontinuities into serious and dangerous flaws. Actually discontinuities do not spread at all when exposed to normal stress, and there is no reason whatever to believe that the discontinuities reduce the effective strength of the material when working under normal conditions. When the material is stressed abnormally the discontinuities do not exert any effect so long as the principal stresses are applied parallel to the length of the discontinuities, *i.e.* parallel to the grain. Where, however, a stress which produces plastic deformation of the material is applied in a direction at right angles to the plane of the discontinuities, the fracture occurs with greater ease across the plane of the discontinuity than through the surrounding material. This unquestionably is the reason of the somewhat lower transverse strength of Duralumin that has been pointed out above.

So far as strength is concerned, therefore, the discontinuities in Duralumin only have effect if the material is stressed in such a way as to produce plastic deformation. Such stresses never are applied to the material in ordinary engineering practice and service. Static stresses that are within the elastic limit, or dynamic stresses within the fatigue range do not produce plastic deformation and, therefore, under either conditions the material is not affected by the discontinuities. Such stresses are, of course, the rule in engineering service, and it is safe, therefore, to say that Duralumin is none the worse as an engineering material because of the existence of what are called discontinuities. The method of fracture by bending does, of course, produce those conditions which tend to produce severe distortion at right angles to the grain, and it is in consequence of this method of fracture that the facets become visible.

Briefly then it may be summarised that the discontinuities in Duralumin are the result of the macro-crystalline formation in the cast material that is characteristic of light alloys of this type. They are not internal defects, and they are not definite potential sources of weakness or fracture in material that is exposed to stresses inferior to the elastic limit and the fatigue limit.

From what has been said it is evident that discontinuities are not likely to constitute a source of trouble in forgings, drop forgings, bars, and such like bulky material. They may, however, be a source of trouble in sheets of medium thickness when such materials are cold worked. Troubles are not frequently experienced even with such material, though it can readily be understood that where the metal is subject to a considerable amount of plastic deformation, rupture may be started at a discontinuity which would not develop in the body of the material. When the metal is being cold-shaped, particularly by such an operation as pressing or spinning, it is inevitable that in certain parts of the material stresses are applied that tend to rupture the metal at right angles to the plane of the discontinuities. Under these circumstances the material is liable to fracture more easily where a discontinuity is located than through the surrounding crystals. This is actually what does happen sometimes in practice. If, however, the material has not fractured during plastic working there is no reason at all to fear that it will subsequently fracture during the normal stressing that is incidental to engineering service.

(*To be continued*).

LUG DESIGN.

By W. S. HOLLYHOCK.

The design of lugs, although very simple mathematically, is a somewhat tedious process, occupying in the aggregate a considerable amount of time unless it is conveniently standardised and condensed.

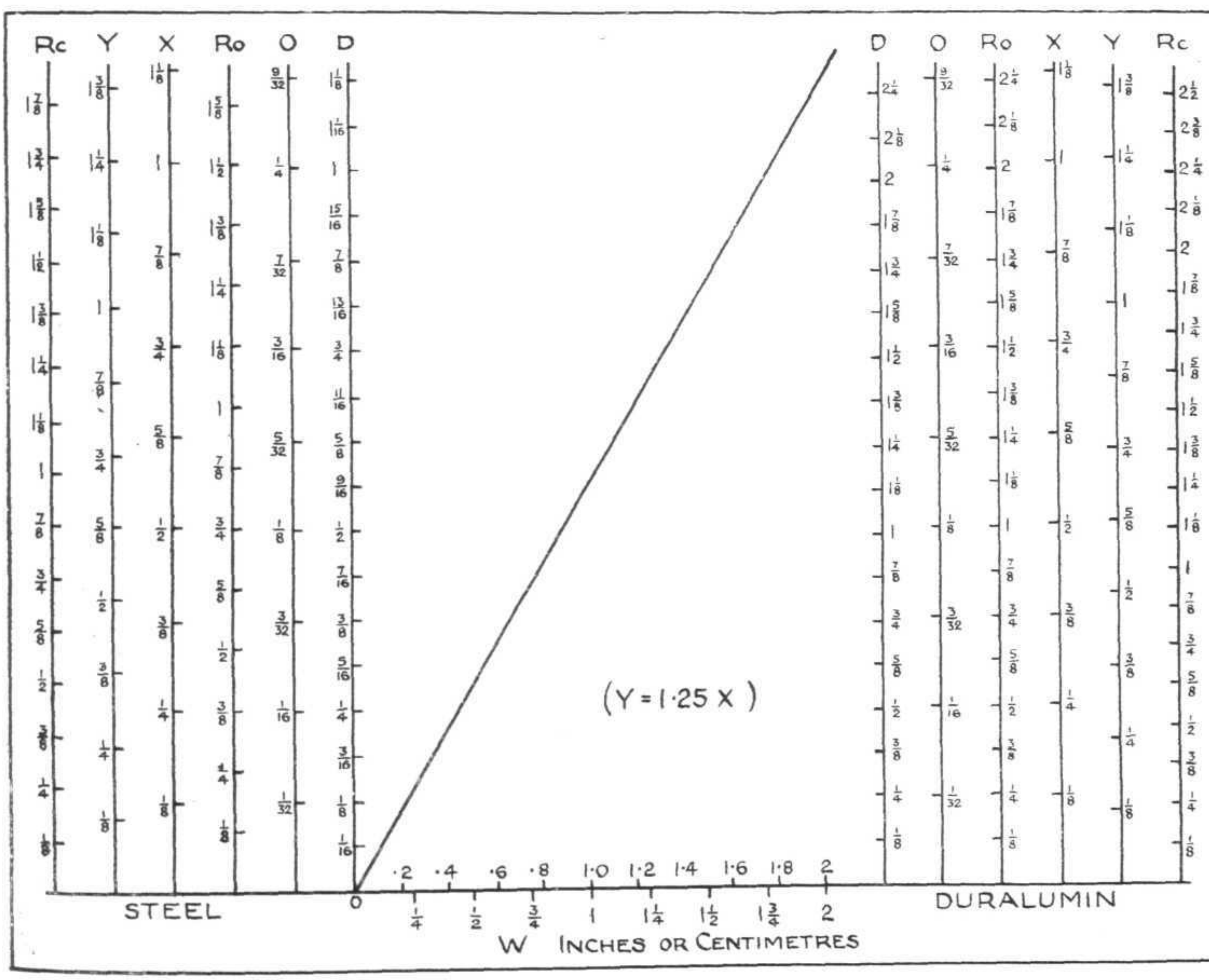

Fig. 3.

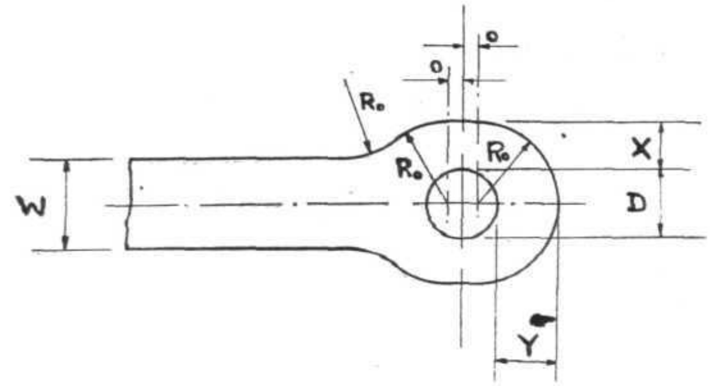

Fig. 1. Offset Lug

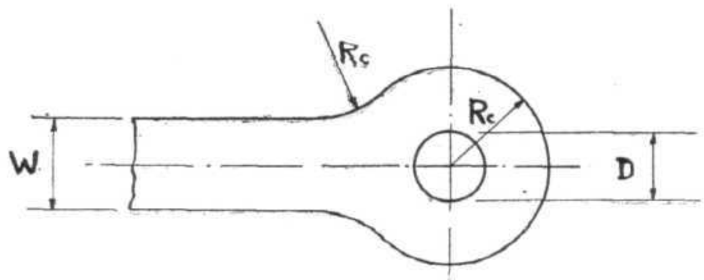

Fig. 2. Concentric Lug

When one remembers that there may be two or three hundred lugs of different kinds and sizes on one machine, a simple and speedy method needs no further recommendation. There are numerous schemes extant, such as graphs, charts and formulæ, but most of them are either unwieldy or conducive to error.

Some of the graphs, though no doubt ingenious, take as much time to elucidate as would be required to work out the dimensions from first principles.

Formulæ, as such, take time to work out and of themselves do not readily admit of comparative inspection. By the time an alternative lug has been worked out the mental conception of the first has faded from the mind.

Charts are not sufficiently general in character and occupy considerable wall space.

The following method, in the opinion of the writer, offers at once a simple and certain means of reading off the dimensions of any ordinary lug practically at a glance.

In the first place, it has been found by experiment that the metal develops only about 90 per cent. of its maximum stress at the section marked X in Fig. 1.

The dimension Y is interpreted differently by various authorities, but $1\frac{1}{4}$ times X is a satisfactory figure, although $1\frac{1}{2}$ times X is quite commonly used.

Let W = The width of the shank.
D = Minimum diameter of pin (for bearing).
O = Offset.
R_o = Radius for offset lug.
R_c = Radius for concentric lug.
f_t = Ultimate tensile stress of the metal.
f_b = Ultimate bearing stress of the metal.

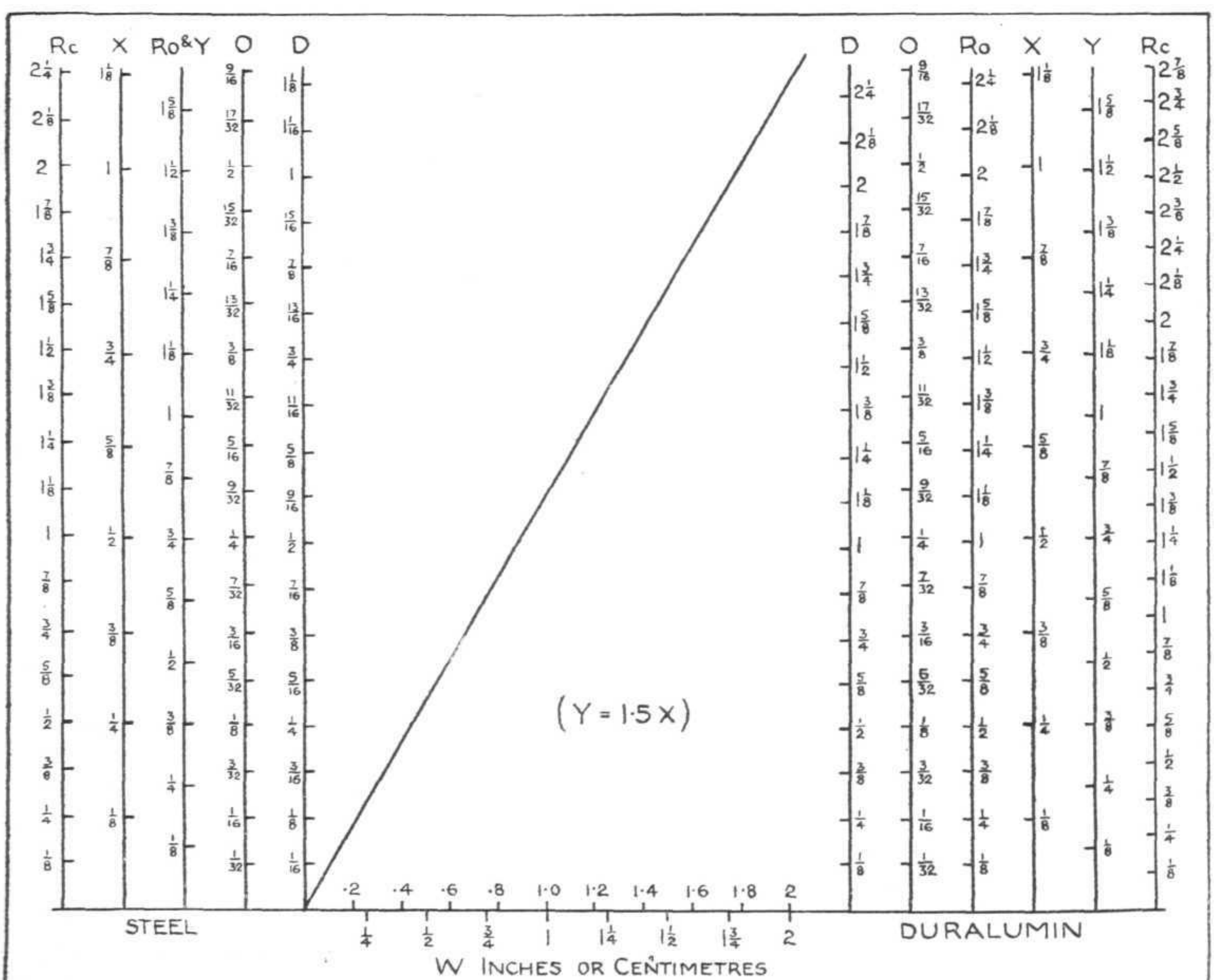

Fig. 4.

$t =$ the thickness.
and $P =$ the tensile load applied (factored)

$$\text{then } W = \frac{P}{f_t \times t} \quad \ldots\ldots (1)$$

$$D = \frac{P}{f_b \times t}$$

$$R_o = X + \frac{D}{2}$$

$$\text{and } O = Y + \frac{D}{2} - R_o = Y - X.$$

Considering for the moment only steel lugs, it will be seen that the ratio $\frac{f_b}{f_t}$ is constant and equals $1 \cdot 77$,

$$\text{therefore } D = \frac{P}{1{\cdot}77 \times f_t \times t} = \frac{W}{1{\cdot}77} (\text{from equation } 1) = 0{\cdot}565W.$$

Again. $2X = \frac{10}{9}$ W (since the metal here only develops 90 per cent. of its maximum stress).

therefore $X = 0 \cdot 555W$.

$$\text{and } R_o = 0{\cdot}555W + \frac{D}{2} = 0{\cdot}555W + \frac{0{\cdot}565W}{2} = 0{\cdot}8375W.$$

$$\text{also } Y = 0{\cdot}555W \times 1{\cdot}25 = 0{\cdot}694W$$

$$\text{therefore } O = 0{\cdot}694W - 0{\cdot}555W = 0{\cdot}139W.$$

For the concentric lug (Fig. 2)

$$R_c = Y + \frac{D}{2} = 0{\cdot}694W + \frac{0{\cdot}565W}{2} = 0{\cdot}9765W.$$

It will be seen that all the dimensions are now in terms of W. A graph may, therefore, be plotted with values of W against values of D, O, R_o, R_c, X and Y.

(See Fig. 3 on page 81.)

The graph (Fig. 3) shows two sets of values—one of which is for steel and the other for Duralumin lugs. The method of procedure for Duralumin lugs is identical with that used for steel except that the ratio $\frac{f_b}{f_t}$ is $0 \cdot 87$ instead of $1 \cdot 77$. (N.B. Since the ratio of ultimate shear stress to ultimate tensile stress is higher for Duralumin than for steel, it would seem that the offsets might be smaller; but since Duralumin is not so reliable at present as steel, this fact is better neglected.) So far, only wiring lugs pure and simple have been dealt with, but if the factor W is considered merely as a basis for computation, it will be seen that all the other factors considered may be adopted for tube-ends, plate fittings and machined lugs in general, both male and female, provided that t equals the *total* thickness of lug.

The general consideration for all lugs are as follows :—

Tension.—The lug can be completely designed from the graph, but the value of D must be great enough for the pin to stand up to the shear stress.

Compression.—The only considerations are shear on the pin and bearing on both pin and lug.

Alternate Compression and Tension.—(*a*) Where the tensile load is greater than the compression load :—

Design exactly as for tension only.

(*b*) Where the compression is greater than the tension :—

Obtain D and t to satisfy the compression load and then, from the graph, find the values of X and Y (using W as a basis) to satisfy the tensile load. R_o and O or R_c can then be found by simple addition.

Where two pins are to be used, the value of Y may be halved and the total width on a section through the pin centres must be at least equal to twice X.

A graph (Fig. 4) showing corresponding values for the case of $Y = 1\frac{1}{2}X$ is appended for the use of those who do not trust the smaller value.

For cases where D exceeds $\frac{1}{2}$ in. however, this graph gives rather excessive offsets which, considering the increasing difference between D and R and the consequent increase of metal where shear stress occurs, are not necessary. So that the writer would advise the use of the former curve for these bigger lugs even if not considered adequate for smaller ones.

N.B.—In Fig. 4, R_o (for steel lugs) is shown as being equal to Y for simplicity in use. The error thereby introduced is of the order of 1 per cent. and is, therefore, negligible.

TECHNICAL LITERATURE.

A.R.C. REPORTS.

THE DISTRIBUTION OF PRESSURE OVER A BIPLANE WITH WINGS OF UNEQUAL CHORD AND SPAN.

By H. B. IRVING, B.Sc., and A. S. BATSON, B.Sc. Presented by the Director of Scientific Research.

R. and M. No. 997 (Ae. 209). (15 pages and 11 diagrams.) December, 1925. Price 1*s*. net.

The increasing use of sesquiplanes has created a demand for wind tunnel experiments on this type of aeroplane, and the present report provides data for stress calculations on a biplane, the chord and span of the bottom wing of which were each two-thirds that of the top wing. The results should be compared with the two reports R. and M. 335, "The Distribution of Pressure on the Upper and Lower Wings of a Biplane," and R. and M. 891, "Pressure Distribution over the Wings of a Model B.E. 2C biplane with Raked Wing Tips."

Measurement of pressure distribution over a R.A.F.15 biplane with lower plane having both span and chord two-thirds of those of the upper plane; gap three-quarters of chord of upper plane; stagger, 20°; range, of incidence, $-4°$ to $+40°$ by 4° steps.

The preponderance of loading near the wing tips for angles of incidence above the stall appears to be more marked than in the normal biplane. (Figs. 6, 7 and 8.)

The measurements are to be extended to the case of a similar biplane to the present one, but with planes of equal span; also to a monoplane up to high angles of incidence. Both these experiments can be made with the existing model aerofoils.

SOME FURTHER EXPERIMENTS ON SINGLE CRYSTALS OF ALUMINIUM EMPLOYING REVERSED DIRECT STRESSES.

By H. J. GOUGH, M.B.E., B.Sc., D. HANSON, D.Sc., and S. J. WRIGHT, B.A.

Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research.

R. and M. No. 1024 (M. 40). (14 pages.) January, 1926. Price 9*d*. net.

The tests described in this report form the first part of a series of endurance tests on single crystals of aluminium, and are directed at the determination of the fatigue range of the crystals under reversed direct stresses. In addition, information has been sought on the change of density, if any, which may take place under alternating stresses. The previous experiments were reported in R. & M. 995*.

Nine specimens were tested under various ranges of stress in the Haigh machine. Five specimens fractured and four remained unbroken under the ranges imposed. In six cases the density of the materials was measured before and after test.

The conclusions reached were :—

(1) The stress criterion governing the failure of the crystals appears to be the highest of the twelve values obtained by resolving the shear stress on each of the octahedral planes in the direction of the three principal lines of atoms on that plane. The tests indicate that in the cases of crystals so orientated with regard to the specimen axis as to be not far removed from the stable position, a range of resolved shear stress of $\pm 0 \cdot 74$ tons/sq. in. is probably a safe range (not necessarily the limiting range). No information has been

* R. & M. 995.—The Behaviour of Single Crystals of Aluminum under Static and Repeated Stresses.—Parts 1, 2, and 3.—Gough, Hanson and Wright.

obtained in the case of crystals otherwise orientated. The Haigh machine set up in the manner as used in the present experiments is unsuitable for testing, in a quantitative way, the resistance of single metallic crystals to alternating stresses. (Reasons for this are discussed in the report.)

The initial orientation of crystals exerts a profound influence on their fatigue endurance.

(2) No change in density of the specimens could be detected to the order of accuracy of the determinations. If any change occurred, it was less than one part in 3,000.

It is proposed to verify the above results by further tests under reversed direct stresses, and also to extend the work to cases in which the mean stress is not zero. Endurance tests are also in hand in which reversed torsional stresses are employed.

GASEOUS COMBUSTION AT MEDIUM PRESSURES. PART I.—CARBON MONOXIDE-AIR EXPLOSIONS IN A CLOSED VESSEL. PART II.—METHANE-AIR EXPLOSIONS IN A CLOSED VESSEL.

By R. W. FENNING, M.B.E., B.Sc., D.I.C.

Work Performed for the Engineering Research Board of the Department of Scientific and Industrial Research.

R. & M. No. 998 (E. 16) (26 pages and 17 diagrams). May, 1925. Price 1*s*. net.

During the past five years a programme of research, involving air-fuel explosions in a closed vessel, has been in progress at the National Physical Laboratory for the Engineering Research Board of the Department of Scientific and Industrial Research. Among the experimental results obtained, those relating to carbon monoxide and methane were considered likely to be of interest and form the subject of the present communication.

Of the two investigations described, the first gives experimental data on the respective influences of hydrogen-air and water vapour on a carbon monoxide-air explosion, and the second relates to explosions of methane and air over a comparatively wide range of initial temperature and pressure.

The report describing this work is illustrated by copies of the indicator diagrams under various conditions, and the results are compared with other workers such as Bone and Haward.

AN INVESTIGATION OF THE AIR-FLOW PATTERN IN THE WAKE OF AN AEROFOIL OF FINITE SPAN.

By A. FAGE, A.R.C.Sc., and L. F. G. SIMMONS, B.A., A.R.C.Sc.

R. and M. No. 951 (Ae. 170). (28 pages and 13 diagrams.) March, 1925. Price 1*s*. net.

The earliest physical conception of the flow in the wake of an advancing aerofoil of finite span was suggested by Lanchester in "Aerodynamics," Vol. I, who showed from theoretical considerations that the flow should comprise a layer of vorticity immediately behind the trailing edge and two general circulatory motions of opposite directions of rotation, one at each aerofoil tip. Other work has since been carried out at Göttingen,* in America (National Advisory Committee for Aeronautics Report No. 83), and at the National Physical Laboratory (see R. and M. Nos. 914† and 989‡).

The present investigation was carried out with a view to obtaining measurements of the wind speed and direction, and to map out the changes which occur in the extent and distribution of the vorticity in the wake as it passes down stream.

The experiments were made with an aerofoil of rectangular plan form, the ratio of span to chord being 6 : 1. Measurements of the speed and direction of the wind were made in three transverse planes behind the aerofoil, at distances 0·573, 2·0 and 13·0 chords from the trailing edge, and also in a plane 0·5 chord forward of the leading edge. Two different velocity meters, of the pressure-tube and hot-wire types, respectively, were employed to obtain a completely independent check on the accuracy of the experimental observations; in general, the results obtained with these two instruments were in close agreement.

The results provide an experimental verification of the theoretical relation given by Lanchester, that the total strength of the vorticity leaving a semi-span of an aerofoil, as obtained by integration over a transverse plane close behind the aerofoil, is equal to the circulation around the median section, and that the distribution of vorticity is closely connected with the distribution of lift along the span. At 13 chords behind the aerofoil the "rolling-up" of the vortex band is almost complete, and within the limits of experimental error the flow is irrotational at a distance of 0·57 in front of the aerofoil and in the regions extending beyond the tips.

Diagrams give the lines of equal vertical and horizontal velocity, the ψ lines and the total vortex strength at various points; all the experimental results are tabulated at the end of the report.

* Prof. L. Prandtl, "Application of Modern Hydrodynamics to Aeronautics," Report No. 116 of the American N.A.C.A.

† Note on the Application of the Vortex Theory of Aerofoils to the Prediction of Downwash.—Simmons and Ower. (R. & M. 914.)

‡ An Investigation of the Flow of Air round an Aerofoil of Finite Span.—Phil. Trans. Roy. Soc., Series A., Vol. 22 (R. & M. 989.)

THE BEHAVIOUR OF CERTAIN AEROPLANES WHEN THE CONTROLS ARE ABANDONED IN STALLED FLIGHT.

By H. L. STEVENS, B.A. PRESENTED BY THE DIRECTOR OF SCIENTIFIC RESEARCH.

R. & M. No. 1020 (Ae. 221) (9 pages). November, 1925. Price 9*d*. net.

The general problem of the control of aeroplanes when stalled has been dealt with at some length in the Report of the Stability and Control Panel, R. & M. No. 1000, "The Lateral Control of Stalled Aeroplanes." The present note arises from discussions during the preparation of this report, and describes the experience obtained in stalled flight of several aeroplanes. The flights were carried out at intervals over a period of some months when time and weather permitted. They were specially directed to investigating the behaviour of stalled aeroplanes when various controls are abandoned.

The case of stalled flight appears, as would be expected, to bear some relation to the lateral geometry of the aeroplane. Of the aeroplanes tested most dived on releasing the stick, and spun when the stick was kept hard back and rudder released. A notable exception was the Avro with large fin and rudder, which performed a lateral oscillation as indicated by the calculations of R. & M. No. 999. "Step-by-Step Calculations upon the Asymmetric Movements of Stalled Aeroplanes." B. M. Jones.

STEP-BY-STEP CALCULATIONS UPON THE ASYMMETRIC MOVEMENTS OF STALLED AEROPLANES.

By PROFESSOR B. M. JONES, M.A., A.F.C., AND MISS A. TREVELYAN.

R. & M. No. 999 (Ae. 206). (22 pages and 37 diagrams.) October, 1925. Price 1*s*. 9*d*. net.

One of the most important questions to be faced by a designer is the behaviour of an aeroplane for given movements of the controls. In the present report a general method has been developed for this purpose, but in view of the large amount of numerical work, it would normally be applied only to special problems. Its importance lies in the predictions that have been made from the mathematical analysis (using wind tunnel results) of the behaviour of aeroplanes in stalled flight. A general discussion of the problem of stalled flight based on this report and other work is given in R. & M. 1000.

The conclusions of the present report are as follows:—

(1) Conventional ailerons are useless in stalled flight, mainly because the yawing moments which they generate set up motions which indirectly overpower, and eventually reverse, their direct action.

(2) A rudder of sufficient power can, in all circumstances, be used to control the attitude of the aeroplane in roll, but its action in this respect, being indirect, is often undesirably slow and cannot be brought into play unless the aeroplane is allowed to yaw.

(3) A rudder of small power cannot control the roll of the aeroplane in all circumstances, so that an aeroplane with conventional ailerons and weak rudder may, in certain circumstances, be uncontrollable.

(4) Ailerons which in reference to body axes develop rolling moments without yawing moments will, in the circumstances examined, control the rolling of the aeroplane without help from the rudder.

(5) When the controls are not moved at all a very small initial disturbance may result in a very large disturbance, particularly when the initial disturbance is in the form of a rate of yaw.

These conclusions conform with such experience of stalled flight as is at present available, viz.:—

(1) Pilots report that, in stalled flight, conventional ailerons are practically useless in all circumstances.

(2) Has been amply verified by experiments upon an Avro and a Bristol Fighter, fitted with exceptionally large rudders.

(3) Is supported by the numerous accidents which occur through involuntary spinning on conventional aeroplanes.

(4) Is confirmed by experiments with slot-and-aileron control.

(5) Is in agreement with observations by Stevens (see secs. 8, 34 of present report); but on the other hand, some aeroplanes when slightly disturbed appear to proceed to a spin without oscillating.

WIND CHANNEL TESTS OF SLOT AND AILERON CONTROL ON A WING OF R.A.F.15 SECTION. PART I.—WHEN THE CENTRAL PORTION OF THE WING IS R.A.F.15. PART II.—WHEN THE CENTRAL PORTION OF THE WING IS SLOTTED AND FITTED WITH A FLAP.

By F. B. BRADFIELD, Maths. and Nat. Sci. Tripos, A. S. HARTSHORN, B.Sc., and L. E. CAYGILL, B.Sc., A.M.I.M.E. PRESENTED BY THE DIRECTOR OF SCIENTIFIC RESEARCH.

R. & M. No. 1008 (Ae. 214) (30 pages and 11 diagrams). November, 1925. Price 1*s.* 6*d.* net.

A slot and aileron control has been developed suitable for fitting to wings of R.A.F. 15 section on the same lines as the control in use on the Avro 504K and described in R. & M. 916.* Other reports bearing on the same subject are R. & M. 968† and 973.‡

The following quantities have been measured for a wing of Bristol Fighter proportions and R.A.F.15 section fitted with Bristol-Frise ailerons and a slot:—

(*a*) Rolling and yawing moments, combined control, $\alpha = 10^\circ$ to 40°; two hinge positions of auxiliary aerofoil.

(*b*) Hinge moments of auxiliary aerofoil, two hinge positions; and hinge moments of balanced ailerons, two hinge positions.

The combined control is as good as that previously found for the Avro; but since the ailerons alone give better results over the stall for the R.A.F.15 than for the Avro wings, the improvement due to the slot is not so great. The hinge of the auxiliary aerofoil must be farther back than was the case for the Avro auxiliary.

The above measurements were extended to cover the case when the wing was converted into a high-lift wing by opening a slot and pulling down a flap extending along the whole of the span. Rolling, yawing and hinge moments were measured under these conditions.

The slot and aileron control is more powerful over the stall with the high-lift wing than with the standard R.A.F.15, but at 30° incidence and over, the control is weaker. The hinge moments are satisfactory. On the model, the flow breaks down for large slot gaps (over 1·4 ins., full scale) which were quite satisfactory with the R.A.F.15 wing, so that the range of slot openings recommended for the R.A.F.15 wing would not be suitable for the high-lift condition of the wing.

Full-scale tests of this control with both types of centre section are being made at the R.A.E. The first flight of the Bristol Fighter aeroplane with R.A.F.15 wings has shown that less balance is required full scale than the model tests would indicate, and a hinge position of 0·2 has been adopted for the ailerons in place of 0·25 chord, the cam being that of Part II, Fig. 10.

* R. & M. 916.—Slot control on an Avro, with standard and balanced ailerons.—F. B. Bradfield.

† R. & M. 968.—Full-scale tests of a new form of lateral control.—H. L. Stevens.

‡ R. & M. 973.—The lateral control of a biplane by combined use of ailerons and varying leading edge slots.—G. P. Douglas and F. B. Bradfield.

ON THE EFFECT OF THE WALLS OF AN EXPERIMENTAL TANK ON THE RESISTANCE OF A MODEL.

By H. LAMB, F.R.S.

R. & M. No. 1010 (Ae. 216). (6 pages and 1 diagram.) January, 1926. Price 6*d.* net.

In all experimental work on models in either air or water the effect of the boundaries enclosing the testing medium is of considerable importance. The interference of wind tunnel walls on models has been discussed in a number of published papers, but the cognate problem of a model tested in water has not been previously solved except for 2-dimensions.

The author has estimated in the present paper the effect of the walls of an experimental tank on the resistance to a model towed along it, the channel being assumed to be cylindrical and the shape of the model based on Rankin's plan. The corresponding problem in two dimensions has been discussed in the Report of the Experimental Tank Committee (see N.P.L. Collected Researches, Vol. 6, p. 46).

The author finds that under certain assumptions for the model having a ratio of length to beam of 5 : 1, the effect of the wall is less than 1 per cent., provided the width of the channel is twice the length of the model.

A TEST ON A SPECIMEN CONSISTING OF THREE CRYSTALS UNDER REVERSED TORSIONAL STRESSES.

By H. J. GOUGH, M.B.E., B.Sc., S. J. WRIGHT, B.A., and D. HANSON, D.Sc.

Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research.

R. & M. No. 1025 (M. 41) (5 pages and 6 diagrams). January, 1926. Price 6*d.* net.

The present report describes a test on a specimen of aluminium, consisting of three crystals, under reversed torsional stresses. The test was carried out in order to obtain some preliminary information as to the effect of the crystal boundaries on the distortion and fracture of the specimen and to suggest lines of research by which the results of tests made on single crystals might, in the future, be co-ordinated with work on crystalline aggregates. Other experiments on reversed direct stresses are described in R. & M. 1024.*

The test piece was subjected to reversals of the following ranges of torsional stresses: $\pm 0\cdot64$ tons/sq. in., $\pm 0\cdot75$ tons/sq. in., and ± 1 ton/sq. in. The surface was examined at various stages and the slip phenomena and etching effects observed were recorded.

The conclusions reached were:—

(i) In general the slip bands observed were similar to those resulting from similar tests on single crystals.

(ii) The neighbouring crystals appeared to exercise a "shielding" effect on the slip. This effect was not well marked in the case of neighbouring crystals having nearly identical orientations.

(iii) In the later stages of the test, etching with 2 per cent. H.F. revealed curious dark bands in the regions of heaviest

* R. &. M. 1024.—Some further experiments on single crystals of aluminium employing reversed direct stresses.—H. J. Gough, M.B.E., B.Sc., D. Hanson, D.Sc., and S. J. Wright, B.A.

slip. Similar effects have since been obtained with single crystal specimens.

(iv) The course of the final crack was such that it intersected the crystal boundaries almost orthogonally. No indication of intercrystalline fracture was found.

The work being of a preliminary nature only, further tests of the same kind, and also tests employing other forms of loading, will be made. It is also hoped to study the effect of varying grain size on fatigue phenomena.

SOME MECHANICAL TESTS OF CAST BARS OF ALPAX.

By H. J. TAPSELL, A.C.G.I.

R. & M. No. 1011 (M. 34) (9 pages and 2 diagrams). December, 1925. Price 9*d.* net.

The work has been carried out in accordance with the approved programme on the mechanical properties of alloys of silicon and aluminium.

The paper deals with the results obtained of some mechanical properties, at air temperature and at elevated temperatures, of cast silicon-aluminium bars ($1\frac{1}{8}$, 2 and 3 ins. diameter) called "Alpax," supplied by Messrs. Lightalloys, Ltd.

Results are given of the following tests: Tensile tests, notched bar impact tests, Brinell hardness tests, and fatigue tests under direct reversed stresses.

This material is a valuable casting alloy. The ultimate tensile strength compares favourably with that of chill-cast Y alloy, though inferior to that material in the heat-treated condition. The elongation is unusually high for a cast-aluminium alloy. The tensile strength falls steadily with rising temperature. At 250° C. the value—7 tons/sq. in.—is much lower than that of Y alloy as cast. At 350° C. the value—4 tons/sq. in.—does not compare well with that of Y alloy—7 tons/sq. in. for material as cast and nearly 12 tons for cast heat-treated material. In the sand-cast state this material is only slightly inferior and gives still a high elongation and tensile strength. Castings up to 3 in. diameter are only slightly inferior in mechanical properties to castings of 1 in. diameter.

The material is not free from casting defects. In this respect the 1 in. diameter chill-cast bars were least satisfactory, a number of them containing large cavities. The sand-cast bars were quite satisfactory. The bars of larger diameter, 2 and 3 in., were also, on the whole, satisfactory. The cavities detected in them were small for castings of such dimensions.

The fatigue range is fair for a cast-aluminium alloy, but does not approach the results given by some heat-treated alloys.

FURTHER EXPERIMENTS ON THE RELATION BETWEEN SKIN FRICTION AND HEAT TRANSMISSION.

By Miss DOROTHY MARSHALL, B.Sc.

Work performed for The Engineering Research Board of the Department of Scientific and Industrial Research. R. & M. No. 1004 (Ae. 211). (19 pages and 11 diagrams.) June, 1925. Price 1*s.* net.

Several previous workers, commencing with Osborne Reynolds in 1874, have made experiments to find the relation between the heat lost by a hot surface when cooled by a current of air passing over it, and its frictional resistance. Later work has been described in the reports of the Aeronautical Research Committee, R. & M. 94,* 1913, and R. & M. 243,† 1916. The experiments here described consist of two distinct series of tests:—

(1) Tests made on a short heated section of pipe 5 in. in diameter through which a current of air was forced, the heat transmitted being estimated from the rise of temperature of the air.

(2) Tests made on thin short cylinders or rings of nickel supported in the 3 ft. wind channel and heated electrically, the heat transmitted being measured from the energy supplied to the rings.

In the second series of tests the surfaces of one cylinder were artificially roughened.

* R. & M. 94. Surface cooling and skin friction.—Lanchester. With an Appendix by T. E. Stanton, D.Sc., M.Inst.C.E.

† R. & M. 243. Heat transmission over surfaces.—N.P.L.

As regards quantitative agreement between the observed heat transmission and the theoretical heat transmission calculated from the measured surface friction, the results of the pipe experiments showed as before a considerable discrepancy between the two quantities.

In the experiments with smooth rings, the calculated heat was some 20 per cent. less than the observed heat; but with the roughened rings the deficiency was less, the second roughened ring giving fairly close agreement between the two values over a considerable range of speed.

The investigation has proved of considerable interest in its bearing on the surface friction of thin plates in the neighbourhood of the leading edge, and the results are in fairly good agreement with the law of surface friction deduced by Blasius from the Boundary Layer Theory of Prandtl, both as regards the law of variation of frictional resistance with speed and the actual values of the forces.

As regards the effect of surface roughness, the experiments show that this depends to a greater extent than was anticipated on the dimensions and forms of the irregularities which constitute the roughness.

SOME COMPARATIVE FATIGUE TESTS IN SPECIAL RELATION TO THE IMPRESSED CONDITIONS OF TEST.

By H. J. GOUGH, M.B.E., B.Sc., and H. J. TAPSELL, A.C.G.I. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. R. & M. No. 1012 (M. 35). 21 pages. April, 1926. Price 1*s.* net.

The report contains the results of a lengthy series of endurance tests on the two steels adopted by the Aeronautical Research Committee as standard material for comparative tests by various investigators. Three types of testing machines —the Haigh, Wöhler and Stromeyer—have been used and three types of specimen have been employed. It is shown that the varying results obtained cannot be reconciled on any simple basis, such as, for example, the criterion of limiting shear stress.

When, however, the results are discussed with reference to the impressed conditions of test, *i.e.*, the modifications in the conditions of stress and strain in the test piece, caused by super-elastic straining within the fatigue range and brought out by the characteristics of the testing machine used or of the shape of test piece employed, it is shown that the variations in calculated values of the fatigue range are of a similar order to those which would be expected from theoretical considerations.

Hence, the main result of the investigation is to furnish direct experimental evidence of the importance of the impressed conditions of test. From the practical point of view, this is equivalent to emphasizing the importance of ductility in a material which is subjected to fatigue action.

The following is an account of some experiments on the fatigue strength of various metals which have been made from time to time, in the Engineering Department of the National Physical Laboratory. Some of the general conclusions that can be drawn from the results of these tests may be of interest as they throw some light on various fundamental aspects of fatigue testing which have been rather neglected in the past. It is proposed to discuss the present results chiefly from two aspects:—

(1) The influence of the type of loading employed on the fatigue strength of the metal under test and;

(2) The influence of the shape of specimen employed on the fatigue strength when specimens of several types are used in the same machine.

A general conclusion that we have reached is that the fatigue range of a metal, as determined using a Wöhler rotating bar machine, is very largely unaffected by the type of specimen used (solid or hollow).

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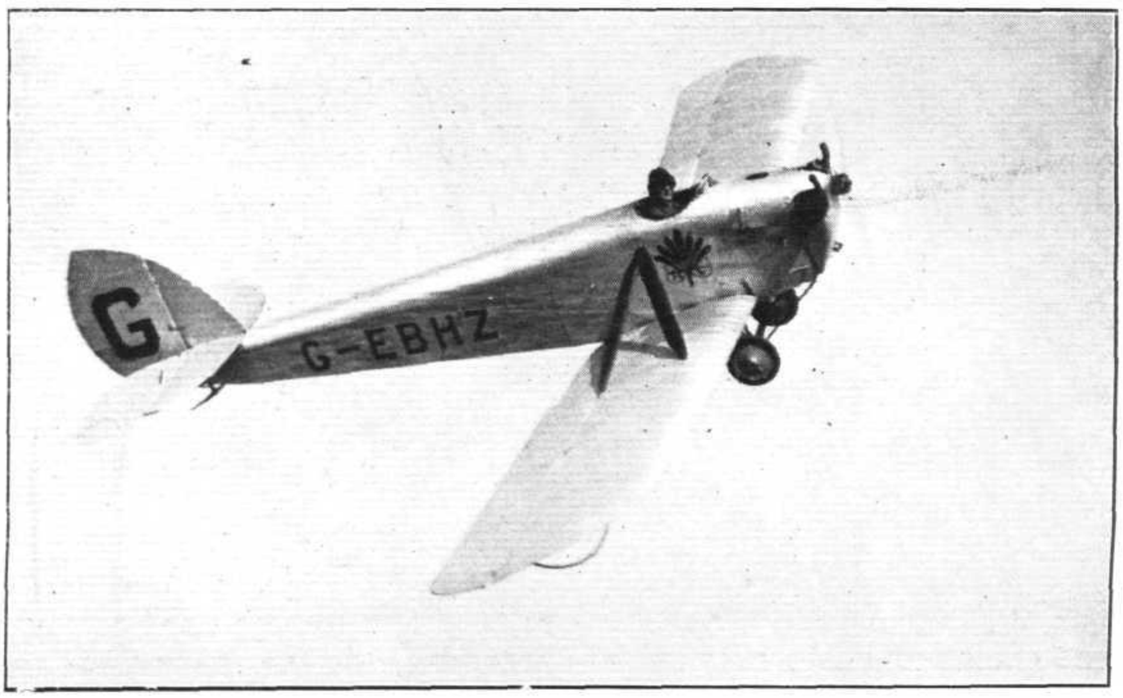
EDDIES FROM LYMPNE

A Seaplane on Wheels: The Short "Mussell" has been fitted with a land undercarriage and took part in Saturday's racing. Below, Mr. John Lord tells Mr. F. Sigrist which machine ought to have won.



Above, The Accusing Finger: Sir Philip Sassoon, Under-Secretary of State for Air, indicates to "Flight's" photographer ample scope for his camera in the form of Lord Edward Grosvenor, while, Lieut.-Col. Sir Francis McClean abandons, for a moment, his role as a very "frank" McClean in the competition. Right, A very fine little Machine: The de Havilland 53 belonging to the Seven Aeroplane Club flies like a small Scout in spite of the fact that its engine is an A.B.C. of some 35 h.p. only.

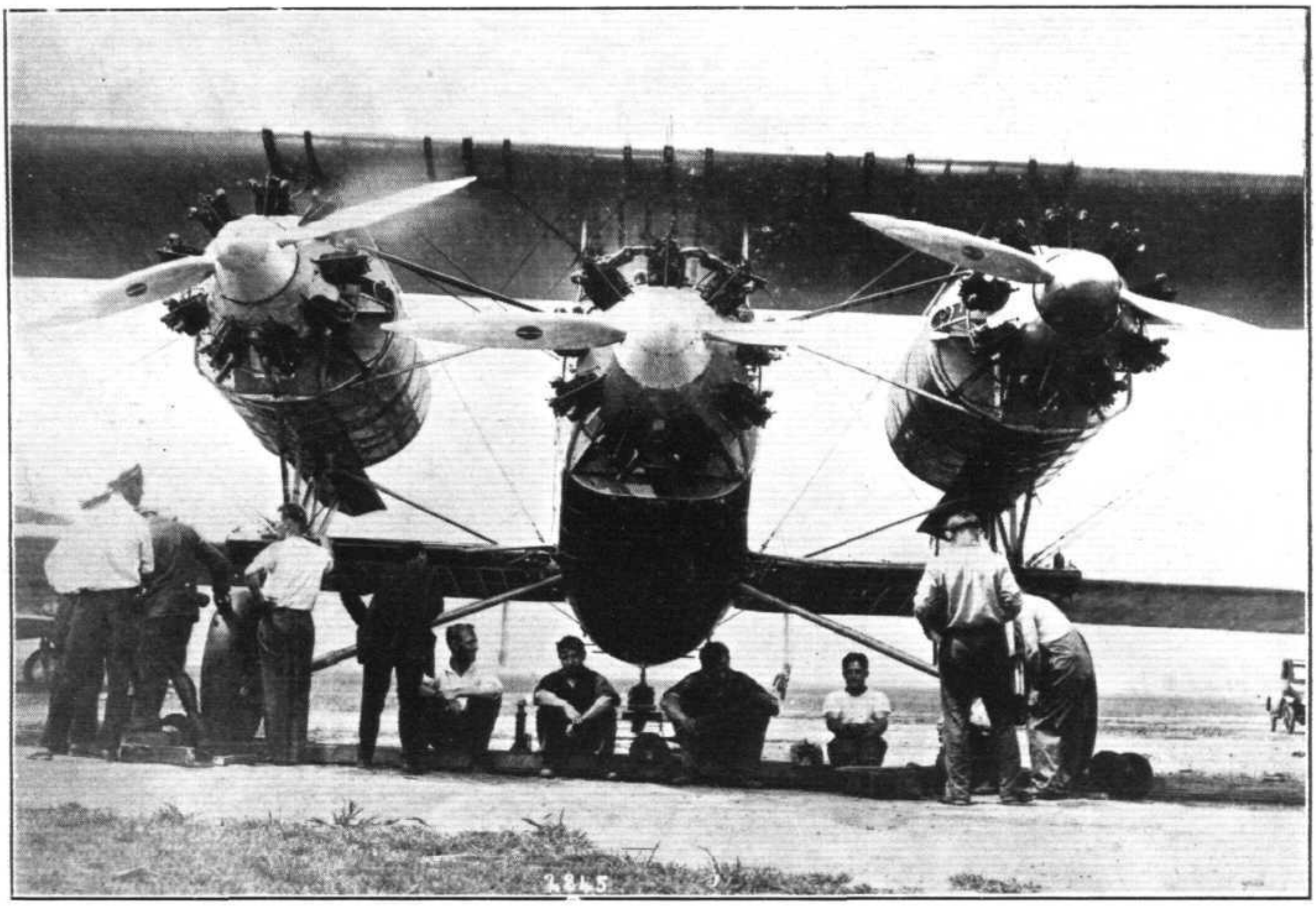
["FLIGHT," *Photographs*

THE SIKORSKY S.35

The Three-Engined (" Jupiter ") Transatlantic Biplane

THE Sikorsky S.35 biplane—on which Capt. René Fonck, the famous French Ace, made the tragic attempt to fly across the Atlantic from New York to Paris—was, as its name implies, designed by M. Igor I. Sikorsky the Russian designer and pioneer of the Giant Multi-engined aeroplane. As we have previously mentioned in FLIGHT M. Sikorsky has now settled down in the United States where, under his direction, the Sikorsky Airplane Co. of Roosevelt Field, Long Island, has produced during the last year or so several very successful aeroplanes of various types.

The S.35, which we are able to describe and illustrate this week, was primarily designed as a passenger and freight machine, but for the Atlantic flight certain modifications were made. To these we will refer as occasion arises, as otherwise the machine as originally designed and described herewith is the same as in its Atlantic form.



THE SIKORSKY S.35 3-ENGINED BIPLANE: The three engines fitted to this machine are 400-h.p. Gnome-Rhone " Jupiter " air-cooled radials, built in France under licence from the Bristol Co.

THE SIKORSKY S.35 3-ENGINED BIPLANE: Preparing for the Atlantic flight; a general view of Capt. Fonck's machine at Roosevelt Field, New York.

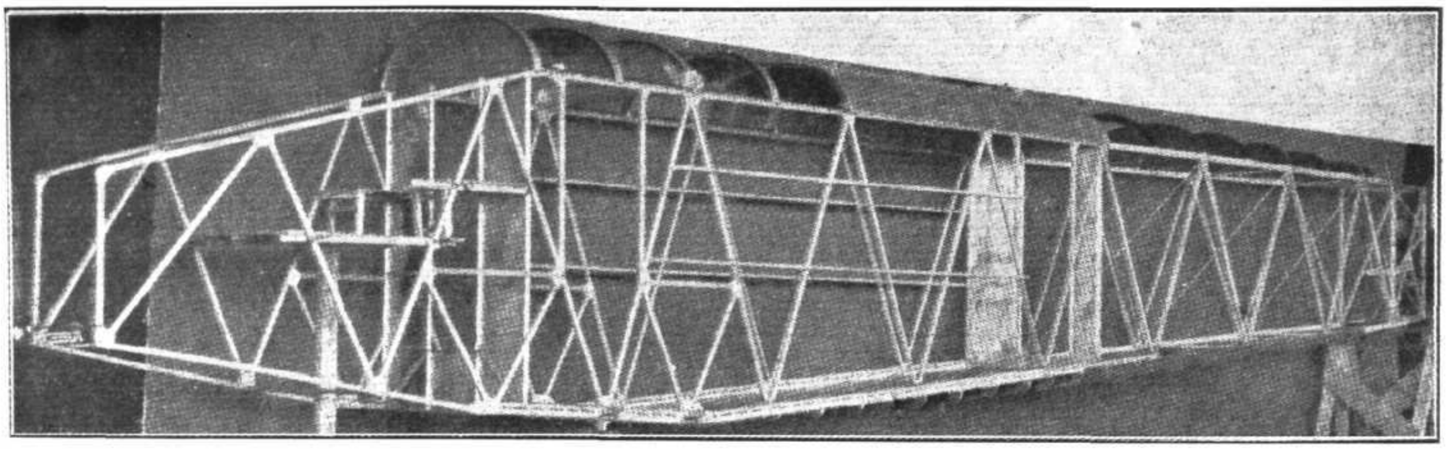
Almost entirely of metal construction the S.35 is the largest of the modern Sikorsky machines and is similar in most respects to some of these previous models. It is a three-engined fuselage biplane with a large upper plane and a much smaller lower plane.

Upper and lower planes have neither sweep-back nor stagger and are braced by two sets of M-struts at the fuselage, and by the wing engine struts, and further by a pair of interplane struts in each of the outer wing extensions. On the Transatlantic machine, however, an extra bay had been added on each side of the wing engines, in order to cope with the extra load of petrol that had to be carried for this flight; in this case, therefore, there are two pairs of interplane struts on each side.

The wing-section employed is one specially developed by Sikorsky, and section and chord are the same throughout the entire span, except at the tips, when the wing is rounded off and raked. Ailerons are fitted on the top planes only. The chord of the top planes being comparatively large—just over 7 ft.—and the wing section somewhat thick, a very deep main spar is obtained.

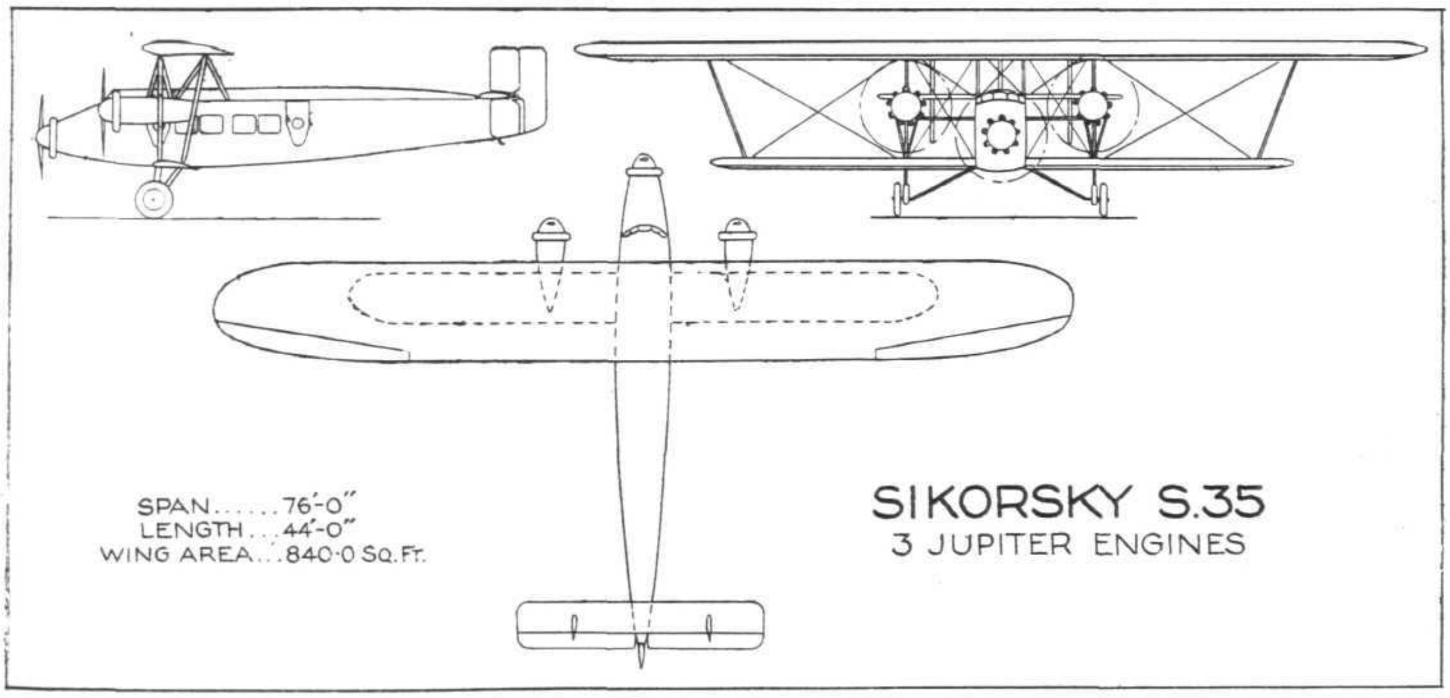
The latter consists of a sheet duralumin web, braced top and bottom by duraluminum angles which are riveted on either side of the central web. The compression wing drag struts between the spars are square section tubes, of the same material, similar to those used in the construction of the fuselage, arranged in the form of an N, lying on its side, with the parallel legs connecting the tops of the spars and the diagonal member running from the bottom of the front spar to the top of the rear spar. Internal wire bracing of the usual type is employed throughout the entire structure.

The ribs are built up of U-shaped duralumin sections, and are extremely strong and simple. Top and bottom cap strips of the ribs are approximately curved to the wing section, and then set in an erection jig when they are braced by a Warren truss system of "U" members. The ribs are then slid over the spar and riveted to stamped duraluminum pieces which rigidly secure the ribs and provide a sound fitting for the curved cap strip over the angular shape of the spar.



The partially finished fuselage of the Sikorsky S.35 3-engined biplane. In this duralumin tubes of square section are mainly employed.

Following the same construction as that of the main planes the horizontal tail surface—composed of two duralumin spars and U-shaped dural ribs, but with drag struts of angle section batterns instead of square tubes—is mounted on the top longerons of the fuselage. There are no vertical fins, but there are three sets of rudders—one centrally mounted on the fuselage sternpost, and a pair on each side on the tail plane with one rudder above and one below the latter. These rudders have the usual Sikorsky compensation arrangement, which consists of offsetting the rudders, which are of aerofoil section, so that if one of the side engines stops the slip stream of the other side engine affects the rudder in such a manner as to counteract the offset thrust, thus adding greatly to safety and ease of control.



THE SIKORSKY S.35 3-ENGINED BIPLANE: General arrangement drawings of the standard commercial type. The "Atlantic" machine had several modifications.

As the S. 35 was originally designed for passenger and freight carrying, the fuselage is of the cabin type, the cabin being exceptionally large and roomy—the actual dimensions being

4 ft. wide by 6 ft. high, by 15 ft. 6 in. long. The pilot's cockpit is located in the nose of the fuselage, which slopes sharply down to the central engine, so that, together with the fact that the lower wing is comparatively small, an excellent range of vision is obtained from all parts of the machine. A duralumin door located at the rear of the cabin provides easy access to the latter.

The fuselage structure consists of a truss system of square duralumin tubes, about 1½ in. gauge, the vertical struts being bolted to the longerons by a simple system of gusset plates which obviates the need of welding and enables parts to be changed when required. The cabin portion is free from cross bracing wires, but the rest of the fuselage is wire braced.

The landing gear is of the divided axle type consisting of two separate units, made entirely of steel with a very wide track—18 ft. 4 in. Each shock-absorbing unit consists of 24 independent rubber rings, readily interchangeable. It is possible to dismount each landing gear unit in a few minutes by removing only three bolts.

For the Transatlantic flight provision had been made for an extra landing gear being fitted, directly under the fuselage in order to cope with the enormous load carried at the start. This extra landing gear could be dropped as soon as the machine got away. Naturally, a large amount of space is provided for petrol, necessary for a flight across the Atlantic. Petrol is carried in four tanks formed in the leading edge of the top plane, in tanks in the wing-engine nacelles, and tanks in the fuselage. The fuel is pumped up to the wing tanks, whence it flows by gravity to the engines. Several fuel pumps are provided and all the tanks can be interconnected or used separately, so that there is little danger of petrol failure during flight. The wing tanks hold sufficient petrol for four hours at full throttle, and for ordinary commercial work only these tanks are employed.

Three Gnome-Rhone "Jupiter" (built in France under licence from the Bristol Co.) 400 h.p. air-cooled radial engines are fitted, one being mounted in the nose of the fuselage and the other two on either side in nacelles midway between top and bottom planes.

The general characteristics of the standard type Sikorsky S.35 are :—

Span	76 ft. 0 in.
O.A. length	44 ft. 0 in.
Height	15 ft. 18 in.
Wing area	840 sq. ft.
Weight, empty	7,200 lbs.
Total weight	13,800 lbs.
Weight per sq. ft.	16.1 lbs.
Weight per h.p...	11.3 lbs.
Speed (est.) range	59—160 m.p.h.
Cruising speed	140 m.p.h.
Speed (two engines)	115-135 m.p.h.
Ceiling	15,000 ft.
,, (two engines)	8,000 ft.
Climb (ground)	1,100 ft./min.
,, (two engines)	400 ft./min

The Atlantic type S.35 had the following modifications :—

Span—	
Top	101 ft. 0 in.
Bottom	76 ft. 0 in.
Wing area	1,095 sq. ft.
Weight empty	8,000 lbs.
Weight of equipment	490 lbs.
Weight of fuel	15,200 lbs.
Total weight	24,200 lbs.
Weight per sq. ft.	21.8 lbs.
Weight per horse-power ..	19 lbs.

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LIGHT 'PLANE CLUB DOINGS

London Aeroplane Club

THE total flying time for the week ending September 19 was 36 hrs. 5 mins.

The following Members were given flying instruction :—Mrs. S. C. Eliott Lynn, Lady Bailey, R. L. Portway, R. A. St. John, H. Solomon, A. J. Richardson, B. B. Tucker, H. F. Wight, D. Usher, Miss O'Brien, J. Barros, J. S. Boult, M. P. Susman, Lady Douglas-Hamilton, H. R. Presland, H. Flintoff, G. Vlasto, J. C. Elford, G. Black, L. C. Crammond, G. C. Bonner, D. P. H. Esler, G. E. Clair, O. J. Marstrand, F. Clarkson, Miss Fletcher, E. Cooper, G. Eady, L. J. C. Mitchell, S. O. Bradshaw, N. Jones.

The following Members flew solo : Lady Bailey, A. H. M. Lees, L. J. C. Mitchell, A. H. Dalton, R. Malcolm, E. G. Richardson, N. J. Hulbert, N. Jones, O. J. Tapper, E. D. Moss.

The following Associate Members were given joy rides :—A. Southgate, A. L. A. Petty, Mrs. M. Bell, E. Anderson.

The total flying time during the week ending September 26 was 51 hrs. 15 mins. The following Members had flying instruction :—Lady Bailey, Miss O'Brien, H. R. Presland, G. Vlasto, W. L. S. McLeod, R. L. Portway, P. O. A. Davison, H. Spooner, H. Solomon, A. S. Richardson, G. Black, R. A. St. John, B. B. Tucker, A. L. A. Petty, G. N. Howe, E. A. Lingard, H. F. Wright, O. J. Tapper, O. H. Best, E. K. Blyth, G. Lyon, Maj. Beaumont, D. Usher, J. G. Crammond, J. H. S. Garne, Sir John Rhodes, J. H. Saffery, F. W. R. Martino, G. Terrell, G. C. Bonner, F. Clarkson, L. J. C. Mitchell, T. C. Sharwood.

The following Members flew solo :—E. E. Stammers, A. G. D. Alderson, R. L. Portway, E. S. Brough, O. J. Tapper, N. Jones, E. D. Moss, G. Terrell, L. J. C. Mitchell, Lady Bailey, W. Hay, E. L. O. Baddeley, B. B. Tucker, E. K. Blyth, A. H. M. Lees, G. H. Craig, Miss O'Brien, Maj. K. M. Beaumont, R. Malcolm, R. C. Presland.

The following Members had joy-rides :—Miss Wilson, A. Southgate, H. Spooner.

On Saturday, 25th inst., Capt. N. Macmillan and Sqdn.-Ldr. M. E. A. Wright kindly assisted in giving flying instruction to members. R. C. Presland successfully completed the tests for his Aviator's certificate on the 22nd inst.

There have been two crashes during the month on G-EBLI and G-EBNP, the members concerned being Miss O'Brien and A. H. Dalton, both flying solo. The necessary repairs have been completed and the two machines are now in use again.

Hampshire Aeroplane Club

REPORT for week ending September 23.—Total flying time, 23 hrs. 20 mins. ; instruction flying, 18 hrs. 45 mins. ; passenger flying, 2 hrs. 45 min. solo flying, 1 hr. 40 min.

The following members received instruction flights :—

Messrs. Fry, 3 hrs. 40 mins. ; Shepherd, 2 hrs. 25 mins. ; Heathcote, 1 hr. 15 mins. ; Rumble, 1 hr. 10 mins.; Nicholson, 1 hr. 10 mins. ; Dobson, 1 hr. ; Keeping, 55 mins. ; Bowen, 45 mins. ; Miss Home, 45 mins. ; Messrs. Malony, 40 mins. ; Fowler, 30 mins. ; Dunning, 20 mins. ; Bound, 20 mins. ; Bishop, 20 mins. ; Courtney, 20 mins. ; Dickson, 20 mins. ; Sommer, 20 mins.; Perfect, 20 mins. ; Westbrook, 20 mins. ; Karry, 15 mins. ; Stokes, 15 mins. ; Southcliffe, 25 mins. ; Cooper, 20 mins. ; Burry, 10 mins. ; Wing Commander Wyllie, 25 mins. ; Lieut. Musslewhite, 10 mins.

The following members flew solo :—Messrs. K. L. P. Bowen, 40 mins. ; O. E. Simmonds, 25 mins. ; Lieut. Musslewhite, 30 mins. ; and Wing Commander Wyllie, 5 mins.

On Tuesday last, several members of the club who hold commissions in the R.A.F., left Southampton in the Troopship *Assaye* for the East, and the ship was escorted down Southampton Water by a flight of Fairey "Foxes" and some "111 D's," and one of the Club "Moths" flown by Capt. Thomson.

The passenger's seat in the "Moth" was occupied by Mrs. Boothman, whose husband was on board the *Assaye*, and Thomson flew round the ship, receiving a rousing cheer from all on board.

Lancashire Aero Club

REPORT for week ending September 24 :—The weather did not interfere with flying during four days. Total time for the week, 42 hrs. 25 mins. Owing to pressure of work in connection with the second flying display, the details are omitted this week, but the outstanding features were the amount of dual put in by Mr. Birley and the number of joy-rides given by Mr. Goodfellow. Fifteen hours' flying were put in on Sunday the 19th, which created a club record.

The club is entering two machines for the second Yorkshire pageant, and thereafter Mr. Stack and the ground staff are being given a few days' well-earned rest. Will all members please note accordingly that the aerodrome will be closed for club flying from the night of October 3 to midday on October 9 ? A full account of the club's air pageant will be found elsewhere in this issue of FLIGHT.

Midland Aero Club, Ltd.

REPORT for week ending September 25 :—Total flying time for week, 12 hrs. 10 mins. One machine only serviceable owing to L.W. being prepared for renewal of Airworthy certificate.

The following Members flew dual :—Capt. Chaytor, Messrs. Fellows, Smith, Swann, Brinton, Brighton, Gibbons, Willis.

The following Members flew solo :—Messrs. C. Knox, E. J. Brighton, G. Perry, W. Swann.

The Austin Whippet was flown solo by a pupil for the first time on Friday last, and, with Mr. H. Willis as the pilot, performed successfully.

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DEATH OF "LARRY" CARTER

WE very much regret to announce that Lawrence Lander ("Larry") Carter, the well-known test pilot of the Gloucestershire Aircraft Company, died in a Cheltenham nursing home on September 27, as a result, we understand, of a sudden attack of meningitis. "Larry" was very popular in the aircraft world and was one of our best and most skilful pilots and had accomplished invaluable test work for this country. He had a distinguished war service record, being responsible for bringing down several enemy aircraft. As regards his civilian air activities, it will be remembered that he made a pioneer flight from England to Sweden with Maj. Tryggoe Gran, M.C., and also made the first commercial flights across the Channel, eventually joining up with the Handley Page Transport Company in this work. In 1922 he won the Aerial Derby on the Bristol monoplane, and again won this race in 1923 on "Gloster I." He then became chief test pilot for the Gloucestershire Aircraft Company, and for them accomplished much valuable research work, until he met with his serious accident. His death comes as a severe shock, for it was thought that he was on the road to recovery.

THE ROYAL AIR FORCE

London Gazette, September 21, 1926

General Duties Branch

Lieut. D. W. Mackendrick, R.N., is granted a temporary commission as a Flying Officer on attachment for four years' duty with R.A.F. (September 1.)

The following Flying Officers are transferred to the Reserve :—Class A.—I. Glyn-Roberts (September 22) ; W.'H. Stiles (September 25). Class B.—A. E. Pitcher, M.M. (September 12).

Flying Officer T. Fetherstonhaugh (Lieut., The King's Royal Rifle Corps) relinquishes his temporary commission on return to Army duty (September 4). The short service commission of Pilot Officer on probation W. F. Ward is terminated on cessation of duty (September 22).

Accountant Branch

Flying Officer B. G. Drake is granted a permanent commission in this rank (September 22).

Medical Branch

Flying Officer D. Magrath, M.B., is transferred to Reserve, Class D 2 (September 24).

Memoranda

The permission granted to Second Lieut. G. Bradbury to retain his rank is withdrawn on his enlistment in the Supplementary Reserve (August 27).

Reserve of Air Force Officers

L. J. C. Mitchell is granted a commission in Class A.A., General Duties Branch, as a Pilot Officer on probation (September 6). The following Pilot Officers are promoted to rank of Flying Officer :—J. D. Sinclair ; May 7. H. Lyne ; June 5. C. R. A. Page ; July 27. E. M. Stewart July 27. H. M. Samuelson ; August 3. C. E. Baldwin ; August 17. A. H. A. C. Cranmer ; August 24. S. W. White ; September 7. The following Pilot Officers are confirmed in rank (September 21) :—J. A. Lincoln, L. R. Winter.

Flying Officer A. L. Harris is transferred from Class A to Class C (September 17) ; Pilot Officer S. Summerfield is transferred from Class AA to Class C (September 21.) Flying Officer H. J. de Waal relinquishes his commission on completion of service and is granted permission to retain the rank of Flight Lieut. (September 12.)

The following Flying Officers relinquish their commissions on completion of service : J. S. Card, A. E. W. Finch, H. C. Peirce, H. F. J. Taylor, H. A. L. Way ; September 12. W. A. Rochelle ; September 16. Flight Lieut. A. H. Dalton resigns his commission on appointment to a commission in the Auxiliary Air Force ; September 3. Flight Lieut. A. S. Goodwin relinquishes his commission on account of ill-health and is permitted to retain his rank ; September 22. The commission of Flying Officer on probation S. Jones is terminated on cessation of duty ; August 20.

AUXILIARY AIR FORCE

General Duties Branch

No. 600 CITY OF LONDON (BOMBING) SQUADRON.—The following to be Flight Lieut. :—A. H. Dalton ; September 3. The following to be Pilot Officer :—D. H. T. Lancaster ; September 2.

Princess Mary's R.A.F. Nursing Service

Miss K. M. Beall resigns her appointment as Sister ; August 13 (substituted for *Gazette*, August 27).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified :—

General Duties Branch

Wing Commanders : H. R. Busteed, O.B.E., A.F.C., to R.A.F. Depot, Uxbridge, for Staff Course at R.N., Coll., Greenwich, 7.9.26. B. L. Huskisson D.S.C., to R.A.F. Depot, Uxbridge, whilst attending course at Senior Officers' Sch., Sheerness, 21.9.26. R. J. F. Barton, O.B.E., to No. 1 Sch. of Tech, Training (Apprentices), Halton, to command No. 4 Apprentices Wing, 19.8.26. J. H. A. Landon, D.S.O., O.B.E., to Station H.Q., Andover, to command, on transfer to Home Estabt., 4.10.26.

Squadron Leaders : W. Thomas M.C., to No. 1 Sch. of Tech. Training (Apprentices), Halton, 19.8.26. R. C. Hardstaff, to No. 10 Group H.Q., Lee-on-Solent, 17.9.26. K. M. St. C. Leask, M.C., to Home Aircraft Depot, Henlow, 18.9.26.

Flight Lieutenants : J. C. M. Hay, T. C. Thomson, R. A. George, M.C., and N. Comper, to H.Q., Cranwell, 6.8.26. L. O. Brown, D.S.C., A.F.C., H. S. P. Walmsley, M.C., D.F.C., G. T. H. Pack, and J. B. Allen, to No. 1 Sch. of Tech. Training (Apprentices), Halton, 19.8.26. P. G. Scott and J. M. Glaisher, D.F.C., to Sch. of Tech. Training (Men), Manston, 20.9.26. J. D. Breakey, D.F.C., to Fighting Area H.Q., Uxbridge, 20.9.26. J. Duncan to R.A.F. Cadet Coll., Cranwell, 20.9.26. C. N. Ellen, D.F.C., to R.A.F. Cadet Coll., Cranwell, 1.10.26. W. Jones to R.A.F. Station, Donibristle, 25.8.26. C. J. Sims, D.F.C., to No. 24 Sqdn., Kenley, 10.9.26. F. E. Bond, to No. 405 Flight, Donibristle, 18.8.26. W. D. Gairdner, D.F.C., to No. 442 Flight, Leuchars, 2.8.26. E. H. Searle to Station H.Q., Kenley, 7.9.26. C. P. O. Bartlett, D.S.C., to School of Tech. Training (Men), Manston, 13.9.26. T. P. Y. Moore, E. J. Cuckney, D.S.C., C. W. Hill, and F. H. D. Henwood, D.F.C., to Home Aircraft Depot, Henlow, 18.9.26. J. A. Macnab, R. E. Meek, W. J. Daddo-Langlois, and A. T. S. Legeun de Lacroix, to Elec. and Wireless School, Flowerdown, 27.9.26. T. J. West, M.C., to R. A. F. Depot, Uxbridge, 18.9.26. G. M. Moore, M.C., to H.Q., Iraq, 2.9.26. L. G. Paget, A.F.C., to R.A.F. Depot, Uxbridge, on transfer to Home Estab., 3.9.26.

Flying Officers : E. S. Steddy to Home Aircraft Depot, Henlow, on transfer to Home Estab., 30.8.26. A. E. Evans, D.F.C., to R.A.F. Base, Gosport, 19.9.26. C. W. McK. Thompson, to Station H.Q., Duxford, 1.9.26. J. W. Hustwaite, M.B.E., L. E. Goodman, and F. H. Cashmore, to H.Q. Cranwell, 6.8.26. J. W. Jean, D.S.M., C. Walker, C. H. V. Hayman, F. H. Davis, A. A. Jones, S. Herbert, and C. E. Galpin, to No. 1 Sch. of Tech. Training (Apprentices), Halton, 19.8.26. G. G. H. Du Boulay to No. 4 Armoured Car Co., Iraq, 1.9.26. E. S. Burns, to H.Q., Cranwell, 1.9.26. C. B. Wincott, to R.A.F. Station, Donibristle, 9.9.26. F. E. Watts, to No. 1 Flying Training Sch., Netheravon, 17.9.26. R. C. Wansbrough and M. C. W. C. Flint, to Electrical and Wireless School, Flowerdown, 27.9.26. C. G. Hancock, A. F. Scroggs, J. B. Lynch, F. C. T. Rowe, O. R. Pigott, D. S. Brooks, H. I. Cozens, A. R. Perry, J. W. Colquhoun, and P. Slocombe, to Home Aircraft Depot, Henlow, 18.9.26. R. O. Jones and A. F. Hutton, to Home Aircraft Depot, Henlow, on transfer to Home Estab., 28.8.26. C. F. C. Coaker and R. F. Findlay, to No. 29 Sqdn., Duxford, 30.9.26. J. W. Thompson and B. F. R. M. Freeman, to No. 5 Flying Training Sch., Sealand, on appointment to Temporary Commns., on being seconded from the Army, 18.9.26.

Accountant Branch

Flight Lieutenants : J. H. B. Carson, to H.Q., Mediterranean, Malta, 25.8.26. H. J. Gilbert, to No. 1 Schl. of Tech. Training (Apprentices), Halton, 27.9.26.

Flying Officers : W. E. V. Richards, to R.A.F. Base, Malta, 25.8.26. J. Charles, to No. 4 Flying Training Sch., Egypt, 25.8.26. S. W. Hill, to Sch. of Tech. Training (Men), Manston, 20.9.26. E. C. Green, to Armament and Gunnery Sch., Eastchurch, 1.9.26.

Pilot Officers : A. E. Fairs, M.C., to Sch. of Balloon Training, Larkhill, 19.8.26. J. A. Stephenson, to No. 207 Sqdn., Eastchurch, 1.9.26.

NAVAL APPOINTMENTS

The following appointments were made by the Admiralty on September 21 :

Lieut.-Commr. A. E. Thomson, D.S.C., to ***Eagle***, and for observer duties, on recmmg. (Oct. 1).

Lieuts : F. M. Walton, to ***Eagle***, and for observer duties, on recommg. (to join on completion of course at R.A.F. Base, Calshot) ; E. R. G. Baker, to ***Eagle***, and for observer duties, on recommg. ; H. T. T. Bayliss and J. D. Harvey, to ***Eagle***, and for observer duties (Oct. 1).

Lieuts. (Flying Officers, R.A.F.) : R. H. S. Rodger, to ***Eagle***, and for full flying duties in 460 flight, on recommg. ; R. F. B. Cecil, to ***Eagle***, and for deck landing training in 441 flight, on recommg. ; and C. John, to ***Eagle***, and for deck landing training in 440 flight, on recommg. (Oct. 1).

THE END OF ALAN COBHAM'S AUSTRALIAN FLIGHT

ALL being well, by the time this issue of FLIGHT is in the hands of most of our readers, " Alan J." will have arrived back in England from Australia, and thus completed yet another of his remarkable long-distance flights. Although Fate has been somewhat unkind as regards his " record dash home," Mr. Cobham has, nevertheless, done remarkably well on the home journey from Australia.

Having arrived safely at Allahabad from Calcutta, through weather conditions resembling the " Curate's egg," on September 21, Mr. Cobham and his companions, Sergt. Ward and Mr. Capel, set out again the following morning on the D.H.50J (Siddeley " Jaguar "), and following the course of the river Jumna, flew to Delhi, where a stop of a little over an hour was made. Proceeding, they completed the day's 800-mile journey at Bahawalpur, and stayed here for the night.

Weather conditions were by now calming down, and on September 23 they covered the 500 miles to Karachi in six and a-half hours, flying against a head wind. The next morning they set out on the journey from Karachi along the Persian Gulf, and made a good flight of 420 miles to Chahbar. Here, unfortunately, a gale sprang up which prevented their taking off again owing to the rollers and heavy swell—Chahbar is not a particularly good base for seaplanes.

On September 25 some difficulty was experienced in getting away from Chahbar, but once away a good trip was accomplished to Jask, where they were received by the British Consul and entertained at dinner in the open, by moonlight. The next morning, September 26, they proceeded to Bushire, and after having refuelled, continued on to Basra. Here Mr Cobham visited the grave of Mr. Elliott, who was shot whilst accompanying him on the outward journey.

Another 800 miles was completed on September 27, when they flew from Basra to Alexandretta, landing at Baghdad for fuel en route. On the following morning they made another 550 miles along the south coast of Turkey to Leros, and after a stop for lunch, proceeded for 200 miles over the Ægean Sea to Athens. Here we must leave them for the present, but it may be added that Mr. Cobham's plans will be to fly on September 29 to Naples and Marseilles. Thence it is proposed that he should proceed to a base at Sartrouville (Seine) in readiness for the final stage tomorrow (October 1) for home, flying via the Thames from Hammersmith to Westminster some time between 2 and 4 p.m. Here he will alight and will be received on the terrace of the Houses of Parliament by Sir Samuel Hoare—but more of this next week.

In Honour of Mr. Cobham.—Several functions have been arranged in honour of Mr. Cobham and his companions, Sergt. Ward and Mr. Capel. In addition to the official Air Council luncheon on October 5, the Institution of Aeronautical Engineers will be giving their dinner, followed by a dance, on October 8 at Kettner's Restaurant (7.45 p.m. for 8 p.m.), tickets for which will be 15*s*. exclusive of wines. The Overseas League, and Sir Charles Wakefield, are also entertaining the airmen.

THE LANCASHIRE PAGEANT

(*Concluded from page* 636)

The judge of this event, as indeed for the whole meeting, was Wing Commander P. Babington, M.C., A.F.C. For this competition Sir Charles Wakefield, Bart., President of the Lancashire Aero Club, had presented a Cup to be held for 12 months, and the winner to receive a replica. Mr. John Lord, of Avro's, had presented a second prize, value £5. It is to be feared that the general public did not quite appreciate the importance of this competition, which was really a very important one, affording as it did an opportunity of demonstrating the skill acquired by Club members during their course of tuition at the various light 'plane clubs. Some extremely good landings were made, and practically no bad ones, and ultimately Mr. R. R. Williams, of the Lancashire Aero Club, was declared to be the winner, with Mr. P. F. Heppell, of the Newcastle Aero Club, second.

While this competition was in progress Capt. Courtney took up the De Havilland "Genet-Moth" and put that through a similar series of stunts as those he had previously given on the Avro "Avian." When Courtney landed Hinkler and Broad swopped machines, Hinkler taking up the "Moth" and Broad the "Avian." The handling these machines received by both pilots was excellent, and such an inter-change of mounts cannot fail to be of considerable value to both firms.

The proceedings came to a finish with the usual "set piece" which, in this case, was an armed enemy mine-layer protected by one aeroplane. The mine-layer was supposed to be discovered by a long-distance reconnaissance machine, and a flight of small Fighters arrived to attack the aerial escort, which was shot down. The Fighters then attacked the mine-layer with light bombs and machine-gun fire. On the arrival of a torpedo-'plane the Fighters climbed to protect it from hostile aircraft attack from above, the torpedo was launched and the mine-layer destroyed.

Finally, the proceedings wound up with the presentation of the prizes to the various winners by Air Vice-Marshal Sir Sefton Brancker, Director of Civil Aviation.

Air Mails. Autumn Suspension

THE Postmaster-General announces that, after September 25 the morning air mail service, London-Paris-Bâle-Zurich, will be closed for the winter. The despaches of letters for Switzerland and beyond by this route, and the supplementary despatches by it of letters for Paris, Morocco and French Senegal, will be suspended. The parcel air mail to Switzerland will also be suspended from the same date.

The Royal Air Force Memorial Fund

THE usual meeting of the Grants Sub-Committee of the Fund was held at Iddesleigh House, on September 23.

Lieut.-Comdr. H. E. Perrin was in the chair, and the other members of the committee present were: Mr. W. S. Field, Sqdn.-Leader E. B. Beauman.

The Committee considerd in all ten cases, and made grants to the amount of £46 4*s*. 6*d*.

The next meeting was fixed for October 7, at 2.30 p.m.

Guildhouse "Five Quarters" Lectures

AMONG the series of lectures given by the Guildhouse at Eccleston Square, S.W.1, at the "Five Quarters" Sunday afternoons, which form the eighth course of addresses on "The Contribution of Science to Human Life," we notice two that should be of particular interest to readers of FLIGHT. One of these is entitled "The Scientific Problems of Commercial Aviation" and will be given by Air Vice-Marshal Sir Sefton Brancker, K.C.B., A.F.C., on October 17, at 3.30 p.m. The second lecture, "Meteorology in the Service of Man" will be given by Dr. G. C. Simpson, C.B., C.B.E., F.R.S., on November 21, at the same hour. Further particulars of the Guildhouse "Five Quarters" Lectures, which are free to all, may be obtained from the Hon. Secretary, Guildhouse Advisory Board, 2, Rosslyn Mansions, Goldhurst Terrace, N.W.6.

Aero Golfing Society

THE Autumn Meeting of the Aero Golfing Society, will be held at Wentworth Park, Virginia Water, on Thursday, October 14, commencing at 10 a.m. The Spring Meeting was put off owing to the Strike, and, therefore, there will be two Challenge Cups to be competed for.

Morning—Medal Round.—1st, "FLIGHT" Challenge Cup; 2nd, Society Tankard; 3rd (Under 12); 3rd (12 and over).

Afternoon—Medal Round.—1st, "Cellon" Challenge Cup; 2nd, Society Tankard; 3rd (Under 12); 3rd (12 and over).

Entries close on October 7, and no entries will be accepted after that date. With the exception of the Challenge Cups, no Member can take more than one prize. How this will be arranged will be decided by the Committee present on the day. Members may select their own partners. The Third Prizes for Morning and Afternoon rounds, are presented by Mr. Fred Cumbers (British Celanese Co., Ltd.).

PUBLICATIONS RECEIVED

Aeronautical Research Committee, Reports and Memoranda: *No.* 1008 (*Ae.* 214).—Wind Channel Tests of Slot and Aileron Control on a Wing of R.A.F. 15 Section. By F. B. Bradfield, A. S. Hartshorn and L. E. Caygill. November, 1925. Price 1*s*. 6*d*. net. *No.* 1011 (M. 34.)—Some Mechanical Tests of Cast Bars of Alpax. By H. J. Tapsell. December, 1925. Price 9*d*. net. *No.* 1025 (M. 41).—A Test on a Specimen Consisting of Three Crystals Under Reversed Torsional Stresses. By H. J. Gough, S. J. Wright and D. Hanson. January, 1926. Price 6*d*. net. *No.* 1026 (*Ae.* 222.)—The Analysis of Experimental Results in the Windmill Brake and Vortex Ring States of an Airscrew. February, 1926. Price 3*d*. net. H.M. Stationery Office, Kingsway, London, W.C.2.

The Elements of Aerofoil and Airscrew Theory.—By H. Glauert. Cambridge University Press, Fetter Lane, London, E.C. Price 14*s*. net.

Aeronautical Research Committee, Reports and Memoranda: *No.* 1004.—Further Experiments on the Relation Between Skin Friction and Heat Transmission. By Miss Dorothy Marshall, B.Sc. Nov., 1925. Price 1*s*. net. *No.* 1012.—Some Comparative Fatigue Tests in Special Relation to the Impressed Conditions of Test. By H. J. Gough, M.B.E., B.Sc., and H. J. Tapsell, A.C.G.I. April, 1926. Price 1*s*. net. *No.* 1021.—The Effect of Metallic Sols in Delaying Detonation in Internal-Combustion Engines. By Flight-Lieut. C. J. Sims, D.F.C., D.I.C., R.A.F., assisted by Dr. E. W. J. Mardles, F.I.C.—Presented by the Director of Scientific Research. May, 1926. Price 6*d*. net. H.M. Stationery Office, Kingsway, London, W.C. 2.

Revue Juridique Internationale de la Locomotion Aérienne. July-August-September, 1926. Per Orbem, 4, Rue Tronchet, Paris.

Bodybuilding in Aluminium. The British Aluminium Co., Ltd., Adelaide House, King William Street, London, E.C 4

AERONAUTICAL PATENT SPECIFICATIONS

Abbreviations: Cyl. = cylinder; i.c. = internal combustion: m. = motor
The numbers in brackets are those under which the Specifications will be printed and abridged, etc.

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